

Table 1: Characteristics and description of studies pertaining to surface-water quality of the MMSD planning area.

Literature Citation (author and publication year)	Characteristics																Description
	Lake information	Stream information	Field measurements	Major ions/dissolved solids	Nutrients	Pesticides	DOC/TOC	Sediment	Bacteria/Viruses	Trace elements/ heavy metals	VOCs, PAHs, PCBs, dioxins, inorganic, organic contaminants	Wastewater treatment plants	Human/animal hormones, caffeine	Urban issues	Modeling	Other	
Ab Razak (1995)		x						x			x						Local study on the Kinnickinnic River to determine the sources of sedimentation and PAHs. First part of century causes were coking operations and coal tar, more recently they have been transportation related.
Ab Razak (1999)		x	x	x	x			x	x	x		x					Study on Milwaukee, Menomonee, and Kinnickinnic Rivers before and after the operation of the deep tunnel to determine its role in reducing pollution. Levels of phosphorus, suspended solids, fecal coliform, zinc, chloride, and BOD were examined.
Ab Razak and others (1996)		x						x		x	x						Local study on the Kinnickinnic River. Sediment cores were analyzed for PAHs and PCBs. The results were examined along with sediment characteristics, clay, silt, and organic carbon to find a correlation.
Anderson (1975)	x		x	x													Statewide classification of lakes by trophic condition. Most lakes examined were 100 acres or larger. Big and Little Muskego Lakes were in the study. It also Discusses lake protection and rehabilitation procedures and classification and management programs.
Arteaga (1989)		x	x						x								Local study on the relationship between bacteria and flagellate populations between Menomonee River and Lake Michigan. Levels were examined in relation to temperature and dissolved oxygen concentrations.
Bannerman and others (1979a)		x	x	x	x			x		x							Local study on the combined loadings of the Menomonee, Milwaukee, and Kinnickinnic Rivers. It also examines the effects of wind-induced suspension of sediment on water quality in the Milwaukee Harbor and its vicinity.
Bannerman and others (1979b)		x	x	x	x		x	x	x	x	x						Study on the Menomonee River watershed. Water monitoring was performed to assess kinds and amounts of pollutants from land drainage of mixed and single land uses. It focuses mainly on suspended solids, phosphorus, and lead but discusses other parameters as well. It also has a section on benthic macroinvertebrate surveys.
Bannerman and others (1983b)			x	x	x			x	x	x							Local study on characteristics, sources, and management of urban storm water pollution in Milwaukee County. This volume characterizes urban stormwater runoff volumes, pollutant concentrations, loadings, and water quality impacts on receiving waters. It also identifies pollutant sources and examined the effectiveness of various frequencies of street sweeping.

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Bannerman and others (1996)		x	x	x	x	x		x		x	x						Statewide study with nine sampling sites in Milwaukee. Samples were taken from storm-sewer pipes and urban streams to determine the quality of stormwater.
Bartošová and Novotny (1999)		x		x				x		x				x	x		Local study using Lincoln Creek to calibrate a model that evaluates the impacts of snow removal and road deicing practices on water quality of urban waters. Data for chloride, lead, suspended solids, and flow is given.
Baumann and others (1980)		x			x			x		x	x			x			Local study of the Milwaukee and Menomonee Rivers. It aims to determine the effects of urban nonpoint source pollution, their characteristics, and a strategy to deal with them. It discusses urban causes of runoff pollutants with a focus on suspended solids, phosphorus, and lead.
Baun (1982)		x		x													Local study with data from the Menomonee River and Honey Creek. The article discusses three methods for estimating pollutant loads in water; integration, composite, and stratified random sampling. It gives recommendations for choosing the most effective method.
Bothwell (1977)			x	x	x												Local study of the Milwaukee Harbor and near-shore Lake Michigan and has a station at the confluence of the Milwaukee and Kinnickinnic Rivers. It investigates phytoplankton populations in relation to nutrients. It also looks at other factors such as temperature, chloride, and alkalinity.
Boyer (1988)								x									Local study on Milwaukee Harbor at the sediment water interface. Sediment-profile photographs were taken to map sediment type. Gas voids and oligochaete worm tubes are also shown.
Cherkauer (1975a)		x		x				x						x			Local study to determine the effects of urban development on water quality in streams. Four small watersheds in different stages of development were examined in response to the same meteorological events. Total dissolved solids and chloride loads were examined.
Cherkauer (1975b)		x		x				x						x			Local study on two small watersheds in the Milwaukee area. One was urban and the other an agricultural watershed. Flow and pollutant loads were compared between the two after a rainfall.
Cherkauer and Ostenso (1976)	x			x										x			Local study on Northridge lakes in Milwaukee. The effects of salt from winter surface runoff are examined. There was shown to be salinity stratification until the spring thaw and salt concentration in lake outflow remained high year round.

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Christensen and Lo (1986)								x			x						Local study on Milwaukee Harbor. A sediment core was taken from the inner harbor, dated, and analyzed for PCBs. The results were compared with Lake Michigan information. Concentrations were shown to follow sales records of PCBs.
Christensen and others (1997a)		x						x			x				x		Local study on the Kinnickinnic river to determine sources of PAHs. A chemical mass balance model was developed and used on dated sediment cores.
Christensen and others (1997b)			x	x	x												Local study on Milwaukee Harbor and its pollution plume. Data for ammonia, chloride, and turbidity were examined. It showed that improved water quality can be obtained by extending or relocating Howard intake pipe.
Citizens' Advisory Committee (1981)												x		x			A report written to educate the public of water quality issues pertaining to the Milwaukee Water Pollution Abatement Program. Its goal was to show the need for public involvement in working towards a solution.
City of Milwaukee Wisconsin Department of Public Works and Consoer and Townsend and Associates consulting Engineers (1974)		x	x	x	x				x						x		Local study looking at effectiveness of detention tanks in preventing combined sewer overflows. Five years of data and modeling studies were done on Milwaukee River in which the water quality was examined in relation to rainfall.
City of Milwaukee Wisconsin Department of Public Works and Consoer and Townsend and Associates consulting Engineers (1975)			x	x	x				x			x		x	x		Local evaluation of a combined sewer overflow detention tank in Milwaukee. Based on modeling studies and data from sewer and river monitoring, detention tanks were shown to prevent combined sewer overflow contaminants from reaching receiving waters.
DeVault (1985)		x				x					x						Multi-state study of tributaries to the Great Lakes with the Milwaukee and Kinnickinnic Rivers included in the study. Fish samples were analyzed for contamination from pesticides and other priority pollutants including PCBs and PAHs.
DeVita (1994)		x									x						Local study on Lincoln Creek. It evaluates semipermeable polymeric membrane devices as concentrators of nonpolar organic contaminants, namely PAHs. Concentration levels are compared in relation to storm events. Uptake by fathead minnows and rusty crayfish were also examined.
Dong and others (1979)		x			x			x		x							Study on the Menomonee River watershed. Metal composition in sand-, silt-, and clay-sized fractions of soil types, bottom sediments, suspended sediments, and dust and dirt samples were analyzed. A method for estimating soil dispersibility was also developed.

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Dong and others (1983b)		x						x		x							Local study on the Menomonee River and the creeks in its watershed to determine the metal contents of soils, street dust, bottom- and suspended-sediments.
Dong and others (1984)		x			x			x									Study on the Menomonee River watershed. Phosphorus levels were compared with particle size of soils, street dust, and bottom- and suspended-sediments. Attempts were made to identify phosphorus sources by particle size composition.
Druckenmiller (1980)	x		x	x	x					x	x						Local Environmental Impact Statement from a plan to dredge Little Muskego Lake. They hoped to improve aquatic life, aesthetic qualities, and recreational uses by deepening shallow areas and controlling macrophyte growth.
Fetter and Feyerherm (1996)					x					x	x						Statewide report on toxic releases to air, water, and land and off site transfers. It includes pounds released to near-by waterbodies.
Fitzgerald (1997)		x		x	x	x	x	x		x	x						Regional study of the Western Lake Michigan Drainages. The purpose is to describe results of a quality-control program. Samples were taken from ground water, bed sediment, tissue, and surface water and analyzed for nutrients, major ions, and other pollutants.
Fitzpatrick and Giddings (1997)		x						x									Regional study on the Western Lake Michigan Drainages with sites on Lincoln Creek and the Milwaukee River. The sites were evaluated for stream habitat. Channel geometry, substrate, streambank and riparian characteristics were examined.
Gergerich (1978)		x	x						x								Local study on Milwaukee and Menomonee Rivers to show the relationship of bacteriolytic organisms with fecally polluted waters. Their presence was compared with levels of sewage-indicator bacteria and abundance was examined in relation to temperature and rainfall.
Ghosh and others (2000)								x			x						Local study on Milwaukee Harbor sediments to determine concentrations of PAHs contained by different types of particles.
Gin (1992)							x										Local study of Milwaukee Harbor Estuary and the rivers that lead into it. Sedimentation was examined by dating cores with the Pb-210 and Cs-137 methods and analyzing them for porosity and total organic carbon.
Graczyk and others (1993)		x			x			x									Statewide study on nonpoint source pollution. It discusses rainfall, water-quality, bed-load, metals, DO, total- and dissolved hardness, and quality control. Data on precipitation and storm water runoff is given for the Menomonee River.

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Great Lakes Commission (2000)		x			x	x		x	x		x			x			Multi-state review of Lake Michigan basin and subwatersheds, one of which is the Milwaukee River and Estuary. It discusses monitoring that is being done and recommendations for further actions that are needed.
Hajda (1993)		x			x										x		Local study on Milwaukee River to estimate the impact of the removal of the North Avenue Dam by using a mathematical model. Data was given for levels of ammonia, nitrate, inorganic and organic phosphorus, chlorophyll-a, BOD, DO, organic nitrogen and discharge.
Hajda and Novotny (1996)		x	x		x										x		Local study on the Milwaukee River to assess the effect on water quality by the presence or absence of the North Avenue Dam. A model incorporating phytoplankton production was used and estimated the effects the removal of the dam would have on DO, chlorophyll-a, BOD, and nutrient levels.
Hansen and others (1983)			x	x	x			x		x							Local study on storm water pollution in Milwaukee County. This volume presents the procedures used for the field monitoring data in volumes one and two. It also describes the sites that were examined in the study.
Harsch (1972)		x	x	x	x	x	x		x	x							A collection of papers concerning the Menomonee River. Section A contains scientific investigations and research data. Section B examines sociological and economic problems of pollution and examinations of types of abatement.
Hussa and others (1973)		x									x						Local report on the Little Menomonee River after children received chemical burns from creosote while in the river. Analysis of samples from the site were done. The report includes a compilation of letters of groups examining the problem.
Jodie (1974)			x	x	x				x	x							Local study of stormwater runoff taken from two urban freeways in Milwaukee. The samples were shown to be of poor water quality after compared to samples from Jones Island Sewerage Treatment Plant, the Menomonee River, other stormwater data, and Wisconsin standards.
Johanson (1990)		x	x	x	x					x							Local study on the Milwaukee River and the Blue Hole abandoned landfill. The purpose was to define the hydrogeology and contaminant distribution in the landfill and to determine the effects of ground water from the Blue Hole site on the water quality of the Milwaukee River.
Kasun (2001)		x	x							x					x		Local study on Oak Creek and the Menomonee River. The objective of the research was to predict the bioavailable concentrations of heavy metals in interstitial porewater and examine the ecological risk by looking at benthic macroinvertebrates.

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Kincaid (1981)			x	x	x					x	x						Local study on acid rain and its sources and effects in Milwaukee. Runoff is also evaluated with data on pH and other chemical parameters.
Kleinart and Degurse (1972)	x	x								x							Statewide study of mercury concentrations in Wisconsin fish and wildlife. Includes fish from Milwaukee River and Milwaukee Harbor.
Kohler (1982)	x		x		x												Local study on Big Muskego Lake examining the phytoplankton population. It was examined to see how it was affected by biological and phsio-chemical factors such as nitrogen, phosphorus, pH, DO, or zooplankton.
Konrad and Kleinart (1974)										x		x					Statewide investigation on toxic heavy metal discharge sources and effectiveness of removal treatments. It contains information for the Milwaukee area.
Konrad and others (1978)		x		x	x			x		x					x		Local study on Menomonee River watershed. They examined land use, phosphorus, lead, and suspended solids data to create a model to describe the washoff of pollutants from land surfaces.
Konrad and others (1979)		x	x	x	x			x	x			x		x	x		Local study describing ground-water impacts on the quality of the Menomonee River. Loading rates are quantified and major contaminants and sources are identified. A predictive model was tested to measure ground-water response to changes in land use or management practices.
Korth (1978)		x						x			x						Local study on the Milwaukee River to determine the affect that algae has on the sediment oxygen demand. It was not shown to be a significant source.
Kreutzberger and others (1980)		x	x					x				x			x		Local study on the Milwaukee River to show that sediments are the source of wet weather oxygen demand. A model was created to predict the impact of combined sewer overflows on dissolved oxygen levels.
Krumbiegel (1970)		x	x	x					x			x		x			Local study on the Kinnickinnic River to determine the effect of the flushing station on water quality. Four sampling sites one at the flushing tunnel outlet, one upstream and two downstream of the outlet were used. Samples were tested for dissolved oxygen, biochemical oxygen demand, pH, turbidity, chlorides, and fecal coliform.
Lai (1995)		x						x		x					x		Local study using Monte Carlo methodology to create a model. It was used to simulate water and sediment quality of a reach of the Milwaukee River that included an urban impoundment for toxic metal pollutants. They hoped to predict the effect of abatements like removal of the North Avenue Dam on water quality.

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Lee and others (1981)			x	x	x				x			x					Local study on biological and chemical water quality in Milwaukee Harbor and Lake Michigan. It determines the mixing and transport of MMSD effluent plumes. Indicator bacteria and viruses are also investigated.
Lenz and Rheume (2000)		x	x		x												Regional study of the Western Lake Michigan Drainages. Lincoln Creek and Milwaukee River are included in the study. Distribution and community structure of benthic invertebrates is discussed and used as water quality indicators. Environmental setting and habitat are also examined.
Li and others (1998)		x						x			x						Local study on the Milwaukee Harbor Estuary. Sediment samples were analyzed for PAHs. Grain size, porosity, and total organic carbon were also determined. The results overview the impact of industrialization in the Milwaukee area.
Lo (1982)								x			x						Local study of the Milwaukee Harbor developing a simple and inexpensive way to determine PCBs in sediments using three aroclars. Pb-210 dating was used and sedimentation rates determined.
Mace (1984)		x	x		x												Regional study on southern Wisconsin streams for setting appropriate water quality goals or standards for amounts of phosphorus. Milwaukee River is included in the study. Nutrient levels were compared to macrophyte and algal growth and its effect on DO concentrations was examined.
Martin and others (1983)	x		x														Statewide examination of Wisconsin Lakes. The trophic condition of about 3000 inland lakes were assessed using Landsat satellite data. Waterbodies from Ozaukee, Washington, and Waukesha Counties were included in the study.
Masterson and Bannerman (1994)		x	x	x	x		x	x		x	x						Local study on rivers and creeks in Milwaukee County. Chemical analysis was performed on sediment, fish, crayfish tissue, and water samples to determine the effects of stormwater runoff. Bioaccumulation was examined and an index of biotic integrity for macroinvertebrates was performed.
Meinholz and others (1979)		x	x	x	x		x	x	x	x		x			x		Local study on the impacts on the Milwaukee River following wet weather discharges. DO concentrations and fecal coliform were monitored in relation to flow. Other chemical characteristics were also examined.
Mildner (1978)		x		x	x			x		x							Multi-state study to evaluate the effect of material eroded from riverbanks on water quality of the Great Lakes. Riverbank protection measures and costs were determined. The Menomonee River and Germantown watershed were used as study sites.

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Miller and others (1992)		x										x					Local study on the Root River. The results are discussed in relation to the objectives of the 1980 Root River Nonpoint Source Water Pollution Plan to determine if the goals of the plan are being achieved.
Milwaukee Metropolitan Sewerage District (1976)			x	x	x				x			x		x			Description of MMSD’s Master Facilities plan designed to reduce water pollution. It includes an analysis of alternate solutions and an explanation of the pollution problems and their causes.
Milwaukee Metropolitan Sewerage District (1980a)			x	x	x				x	x	x	x		x			Report on a plan for combined sewer overflow abatement. It examines environmental impacts on the Milwaukee, Menomonee, and Kinnickinnic Rivers.
Milwaukee Metropolitan Sewerage District (1980b)			x	x	x				x			x		x			Report on a plan for Franklin-Muskego Interceptor Facility. It includes environmental assessment with information on Little Muskego Lake, Big Muskego Lake, Little Muskego Creek, Tess Corners Creek, and the Root River.
Milwaukee Metropolitan Sewerage District (1980c)		x	x	x	x				x			x		x			Report on Franklin - Northeast Interceptor Facility plan. It examines the status of the Root River and the effects that the proposed plan will have on it.
Milwaukee Metropolitan Sewerage District (1980d)			x	x	x			x	x	x	x	x		x			Local plan for Jones Island Facility. It discusses existing environmental status and the impacts the plan will have on Milwaukee’s Harbor and also includes some information on the tributaries leading into the harbor.
Milwaukee Metropolitan Sewerage District (1980e)		x	x	x	x				x			x		x			Report on the Mitchell Field South Interceptor Facility plan. It examines the status of water in Mitchell Field Ditch and in Oak Creek and states the effects that the plan may have on it.
Milwaukee Metropolitan Sewerage District (1980f)			x	x	x				x			x		x			Local plan for water pollution abatement facilities. It discusses existing and future conditions affecting water quality in the area.
Milwaukee Metropolitan Sewerage District (1980g)		x	x	x	x				x			x		x			Local plan for the Northridge Interceptor Facility with an environmental assessment on Beaver Creek, Trinity Creek, and Milwaukee River. It examines land use and physio-chemical characteristics.
Milwaukee Metropolitan Sewerage District (1980h)		x	x	x	x				x			x		x			Report on the Oak Creek North Branch Interceptor Facility Plan. It examines the status of Oak Creek and the effects the plan will have on it.
Milwaukee Metropolitan Sewerage District (1980i)		x										x					Local plan for the Root River Interceptor Facility with an environmental assessment of the Root River in New Berlin, WI.

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Milwaukee Metropolitan Sewerage District (1980j)		x	x	x	x				x			x					Local plan for MMSD’s Underwood Creek Interceptor Facility with an environmental assessment on Underwood Creek, Dousman Ditch, and the Menomonee River. It discusses land use, some point sources of pollution and physio-chemical characteristics.
Milwaukee Metropolitan Sewerage District (1981)		x	x	x	x							x					Local study on Milwaukee, Menomonee, Kinnickinnic, and Root Rivers. It gives some history of the area and includes data on pollutant loads of phosphorus, BOD, and suspended solids.
Milwaukee Metropolitan Sewerage District (1982)		x	x	x	x				x	x		x		x			Local reports prepared for MMSD’s Water Pollution Abatement Program. It evaluates and refines the 1980 Master Facilities Plan and includes an environmental assessment.
Milwaukee Metropolitan Sewerage District and Stevens, Thompson, & Runyan (1975)												x		x			Plan formed in response to a study that addressed problems due to combined sewer overflows. It gives an overview of the project and their objectives.
Milwaukee River Technical Task Force (1975)		x												x			Report by the Mayor’s Task Force on the Milwaukee River. It gives their recommendations for what needs to be done to improve water quality including land use, reduction of sewer overflows, other agencies’ plans, and continual study.
Mortimer (1981)					x				x			x					Overview of a court case with the state of Illinois vs. Milwaukee and near-by cities. The issue of concern was pollution of Lake Michigan by sewer overflows and discharges.
Myers and others (1994)		x						x	x		x						Study on Milwaukee Harbor, Green Bay, and Lake Erie. There were sampling sites on Milwaukee, Kinnickinnic, and Menomonee Rivers. It investigates the degradation of aromatic compounds found in sediments under anaerobic conditions. It also looks for the role of iron- and manganese-reducing bacteria.
Novotny (1986)			x	x	x		x		x	x	x					x	Local study on Milwaukee to develop a snowmelt runoff model. It can be used to predict snow accumulation and melt in urban areas. Looks at accumulation of pollutants in snow, flow rates, and above all, use of deicing chemicals. A model was used to simulate chloride concentrations and flow.
Novotny and Bendoricchio (1989)		x	x		x							x					Local study with information on the Menomonee River watershed and some of the tributaries and creeks within the watershed. The model LANDRUN was used for estimating sediment loadings from various land uses and other factors like soil characteristics and imperviousness. Phosphorus loadings were also examined.

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Novotny and others (1979a)		x			x			x						x	x		Study on Milwaukee River and the canals of Venice. It examines nonpoint source pollution and looks at problems associated with excess nutrients: its relationship with productivity and oxygen demand. It has some data on dissolved oxygen, nitrogen , and chlorophyll-a levels from the MMSD.
Novotny and others (1979b)		x			x			x							x		Local study using LANDRUN, a model used to estimate the quantity and quality of run-off water and eroded particulates from watershed with mixed land uses. Runoff, sediment, volatile suspended solids, and phosphate data from Novey Creek, Schoonmaker Creek, and the Little Menomonee River were used to calibrate the model.
Novotny and others (1993)		x					x	x		x	x	x		x	x		Local study of the North Avenue urban impoundment on the Milwaukee River. Sediment volume, characteristics, and contamination were examined. Sources of toxic metals were found to be from urban runoff.
Novotny and others (1994)		x						x		x		x			x		Local study of the North Avenue urban impoundment on the Milwaukee River. A model was used to simulate water and sediment quality in areas contaminated by toxic metals.
Ovaska (1995)			x														Local study on the quality of the water taken in by the Howard Avenue and Linwood plants to see if there is a correlation. Turbidity, pH, temperature, alkalinity, and wind velocity were examined.
Owens and others (1997)		x		x	x			x		x							Statewide evaluation of nonpoint source contamination and management practices. Lincoln Creek and Milwaukee River were included in the study. Data was given for precipitation, flow, suspended solids, phosphorus, and metals.
Pariso and others (1983)		x				x		x		x	x						Regional study of Wisconsin's coast. Milwaukee, Kinnickinnic, Root, and Menomonee Rivers and Oak Creek were included in the study. Fish, sediment, and effluent samples were tested for contaminants.
Peters (1997)		x		x				x						x			Regional study on Western Lake Michigan Drainages. It is a compilation of articles on natural and anthropogenic features of the area that have an impact on water quality. These include geology, climate, vegetation, land use, and hydrologic and biological characteristics.
Phoomiphakdeepthan (1994)			x	x	x												Local study examining water quality taken into the Linwood and Howard Avenue Filtration Plants. A change in the location of intake was recommended for the Howard Avenue plant which obtains water flowing from the harbor. The study examined levels of ammonia, chloride, temperature, and turbidity coming from the Harbor.

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R.A. Smith & Associates Inc. and others (1996)		x	x	x	x					x				x			Local study on the Menomonee River. It evaluates the potential of returning it to a more natural state and improving recreational access. Some of the proposed ideas were creating a wetland, making a trail, and removing the concrete lining.
Rachdawong and Christensen (1997)		x						x			x					x	Local study on PCBs from the Milwaukee Harbor Estuary, Inner and outer Milwaukee Harbor, and the Kinnickinnic River. Sediment cores were dated and analyzed to try to determine sources of PCB concentrations.
Richards and others (1998)		x		x	x					x							Regional study of Wisconsin streams in the Lake Michigan Drainage Basin. The study includes Milwaukee River and Lincoln Creek and describes techniques used to collect water samples and methods for analysis. It discusses the effects of some factors on water quality, such as climate, bedrock, and land use.
Robertson (1997)		x			x			x									Regional study on tributaries to Lake Michigan and Lake Superior, including the Milwaukee River. Suspended sediment and phosphorus loads were estimated for unmonitored locations using data from monitored sites, especially during high flows. Stream gradient, land use, and soil type were also examined.
Robertson (1998)		x			x			x									Regional study of the Western Lake Michigan Drainages. It includes Lincoln Creek, Little Menomonee River, Honey Creek, Oak Creek, and the Kinnickinnic River. Stream-flow, nutrients, and suspended sediment data were used to look at the effects on water-quality by land use, surficial deposits, and bedrock type.
Robertson and Saad (1996)		x			x			x									Regional study of the Western Lake Michigan Drainages on ground-water and surface-water resources, including the Milwaukee River. It contains data for nutrient and suspended sediment levels. This information is related to land use and other geologic characteristics, and it assesses streams and discusses implications for future sampling.
Sawicki and Judd (1982)														x		x	Case study on the Root River watershed to determine the effectiveness of a voluntary, decentralized institutional system for managing nonpoint source water pollution. Factors considered were land use, educational needs, economic conditions, personality, water quality, number of agencies involved, authority, and bureaucratic requirements.
Science Applications International Corporation (1993)		x				x		x		x	x			x			Multi-state study on the Lake Michigan Basin. The purpose was to inform the public and get their comments on agencies' activities and future actions. Information on the effects of toxic pollutants in the Great Lakes and their sources is given.

Table 1: Characteristics and description of studies pertaining to surface-water quality of the MMSD planning area.

	Characteristics																
Literature Citation (author and publication year)	Lake information	Stream information	Field measurements	Major ions/dissolved solids	Nutrients	Pesticides	DOC/TOC	Sediment	Bacteria/Viruses	Trace elements/ heavy metals	VOCs, PAHs, PCBs, dioxins, inorganic, organic contaminants	Wastewater treatment plants	Human/animal hormones, caffeine	Urban issues	Modeling	Other	Description
Scudder and others (1996)										x							Regional study of the Western Lake Michigan Drainage Basin. It contains a summary of biology in the region and also has tables of references that have information on biological investigations.
Scudder and others (1997)		x				x	x	x		x	x			x			Regional study on the Western Lake Michigan Drainages. Sampling sites included the Milwaukee River, Kinnickinnic River, and Lincoln Creek. Trace elements and synthetic organic compounds were examined in sediment and biota and were related to bedrock and land use.
Singh (1992)		x									x						Local study on nonpoint sources of PAHs in Milwaukee Harbor Estuary. Samples were taken from the harbor and the Milwaukee, Menomonee, and Kinnickinnic Rivers.
Singh and others (1993)		x						x			x				x		Local study on nonpoint sources of PAHs to the Milwaukee Harbor Estuary. Sediment samples were collected from the Milwaukee, Kinnickinnic, and Menomonee Rivers and the inner and outer harbor. A computer program was used to compare them with source samples and other known concentrations.
Sonzogni and others (1978)		x		x	x												Multi-state summary on loads to the Great Lakes from their tributaries. The Milwaukee, Menomonee, and Root Rivers are included in the study. The report contains data describing levels of phosphorus, nitrogen, nitrates, chloride, and suspended solids.
Southeastern Regional Planning Commission (1976)		x	x	x	x			x	x	x	x	x					Local study on the Menomonee River watershed to provide a plan that will work on the flooding problems and increase the health of the river and its use as a habitat. Physical description of the area is given along with wildlife that is found there. Data for flooding and surface water monitoring is also given.
Southeastern Regional Planning Commission (1978b)		x	x	x	x	x		x	x	x				x			Local study on the Kinnickinnic River watershed to choose a plan that will assist in decreasing flood risk and water pollution. Physical description of the area is given along with flooding and surface water monitoring data.
Southeastern Wisconsin RegionaI Planning Commission (1986c)		x	x	x	x			x	x								Local study on the Oak Creek watershed to provide a plan that will address flooding problems and increase the health of the river and its use as a habitat. A physical description of the area is given along with wildlife that is found there. Data for flooding and surface water monitoring is also given.
Southeastern Wisconsin RegionaI Planning Commission (1987a)		x	x	x	x	x	x	x	x	x	x	x					Local study on the Milwaukee Harbor Estuary which involves the Milwaukee, Menomonee, and Kinnickinnic Rivers, and the Harbor. The purpose was to prepare a plan that will assist in controlling pollution, mitigate flood problems, control storm damage in the harbor, and improve water quality for recreational uses. Monitoring data is given.

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Southeastern Wisconsin Regional Planning Commission (1979)		x	x	x	x				x					x			Local study on the Oak Creek Watershed which also includes the Mitchell Field Drainage Ditch. Existing water quality was evaluated as they formed a program to address flooding, water pollution and other related problems.
Southeastern Wisconsin Regional Planning Commission (1980)		x	x	x	x				x			x		x			Loacal study on the Root River and its tributaries. This plan is for the control of pollution of both urban and rural sources.
Southeastern Wisconsin Regional Planning Commission (1971)		x	x	x	x				x			x		x			Regional study on the Milwaukee River to show the need for comprehensive regional planning. It discusses existing water conditions and problems and gives possible solutions. Topics covered include flooding, water quality, water supply, and recreation.
Southeastern Wisconsin Regional Planning Commission (1977)			x	x	x							x					Regional study that examines point source pollution, especially wastewater treatment. Appendix A lists companies, where they discharge to, and characteristics of the water.
Southeastern Wisconsin Regional Planning Commission (1978a)			x		x				x			x		x			Regional plan to prevent water pollution in southeastern Wisconsin up to the year 2000. It discussed sources of pollution, disposal or use of solids removed from waste-waters, and management responsibility.
Southeastern Wisconsin Regional Planning Commission (1978c)		x	x	x	x				x			x		x			Regional study on the Lake Michigan Drainage Area in Southeastern Wisconsin. The purpose is to show the need for, the major elements, and the organizations of a comprehensive planning program. It has information on the Root River and the Milwaukee Harbor Estuary.
Southeastern Wisconsin Regional Planning Commission (1978d)			x		x			x	x	x		x		x			Regional study of point and nonpoint source water pollution in Southeast Wisconsin. It gives nitrogen, phosphorus, BOD, sediment, and fecal coliform loads from urban and rural sources to different bodies of water.
Southeastern Wisconsin Regional Planning Commission (1978e)	x	x	x	x	x				x	x	x	x					Regional study of lakes and streams in southeastern Wisconsin. Included in the report is data on the Milwaukee, Root, Menomonee, and Kinnickinnic Rivers, and Oak Creek.
Southeastern Wisconsin Regional Planning Commission (1983)												x					Local plan for the city of Germantown for sanitary sewer service. It discusses land use and environmentally significant lands.

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Southeastern Wisconsin Regional Planning Commission (1984)												x					Local plan for sanitary sewer service for Butler, WI. It also includes proposals for an environmental corridor along the Menomonee River.
Southeastern Wisconsin Regional Planning Commission (1987b)												x					Local plan for the city of New Berlin for sanitary sewer service. It discusses land use and environmentally significant lands.
Southeastern Wisconsin Regional Planning Commission (1993)		x				x				x	x						Local plan for flood and stormwater management for Lilly Creek subwatershed. Evaluates alternative plans in hopes to eliminate current problems and avoid future ones while also considering nonpoint source pollution and river habitat.
Southeastern Wisconsin Regional Planning Commission (1994)												x					Local plan for the city of Oak Creek for sanitary sewer service. It discusses land use and environmentally significant lands.
Southeastern Wisconsin Regional Planning Commission (1996)	x		x	x	x	x	x	x		x	x			x			Local management plan for Little Muskego Lake. With the plan they hope to reduce sediment and contaminant loading to the lake, reduce aquatic macrophyte and algal growths, promote public awareness, improve aesthetics and use for recreation, and improve habitat for fish and other wildlife.
Southeastern Wisconsin Regional Planning Commission and others (2000)		x				x				x	x						Local study on Dousman Ditch and Underwood Creed subwatershed of the Menomonee River watershed. It identifies stormwater management and flooding problems and their causes. It also sets forth a management plan after examining alternatives.
Stanley and Erickson (1977)		x	x					x				x		x	x		Local study on the Milwaukee Metropolitan area to design a model that predicts effects on water quality by industry. Major focus is on costs and economic issues
Steuer and others (1999)		x		x			x				x						Local study on PCBs in Cedar Creek and Milwaukee River. PCB levels were compared with total suspended solids and chlorophyll-a concentrations.
Sullivan and others (1980)		x		x	x			x									Regional study of the Great Lakes Basins area. It is an update to studies and management programs of the Pollution from Land Use Activities Reference Group (PLUARG) . It examines pollution loadings to the Great Lakes, especially phosphorus nonpoint sources. The Menomonee River is studied and there is some information on the Milwaukee and Root Rivers.

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Sullivan and others (1995)		x	x														Regional study on the Western Lake Michigan Drainages. Lincoln Creek and the Milwaukee River are included in the study. Data is given for land use, physical characteristics of the streams, and field measurements.
Sung (1983)				x	x					x	x					x	Study on eight watersheds in Milwaukee county to estimate nonpoint pollution and identify its sources. A model was created to help in the design of urban nonpoint source control programs.
Syftestad (1985)			x	x	x												Statewide study that gives data about public water supply facilities and water chemistry data. Samples were taken for each municipal system from raw surface water, raw well water, or finished water distribution samples.
Task Force on Pollution (1983)		x	x		x			x	x								Local examination of data by a task force. They sought to determine if improvements made by the MMSD would be enough to significantly improve water quality in the district or if a point and nonpoint source pollution abatement program was needed outside of the district.
Taylor (1994)		x	x		x			x		x							Local study on the Kinnickinnic River examining nonpoint sources of pollution. Urban runoff and erosion from construction sites and streambanks are the main issues.
Toyingtrakoon (1996)		x	x	x	x			x	x			x					Local study on the Milwaukee, Menomonee, and Kinnickinnic Rivers and the Jones Island wastewater treatment facility to determine the impacts of the deep tunnel. Measurements included levels of phosphorus, BOD, fecal coliform, and suspended solids after precipitation.
Tseng (1978)										x		x					Local study on sludges from Milwaukee Jones Island and South Shore wastewater treatment plants and the Howard and Linwood Avenue purification plants. Samples were tested for heavy metals and they also looked at total solids and volatile solids.
U.S. Environmental Protection Agency (1980a)		x	x	x	x				x	x		x		x			Local study addressing MMSD's Master Facilities Plan. It analyzes what the proposed actions and alternatives would have on the environment and the existing water quality. It includes data levels for ammonia, nitrogen, phosphorus, BOD, pH, flow, fecal coliform, and chlorine.
U.S. Environmental Protection Agency and others (1980b)		x	x	x	x				x	x		x		x			Local study of MMSD area addressing the proposed Master Facilities Plan. It concentrates on the issue of overflows due to infiltration of ground water and storm water. They discuss current water quality and how the plan will affect it.

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Veith (1970)		x	x	x							x						Study on the Milwaukee River to determine the chemical nature of organochlorine compounds found in fish. Analysis procedures were developed and the sources, fate, and concentrations of the compounds were determined.
Veith and Lee (1971)		x	x	x							x						Local study on cholrobiphenyls in the Milwaukee River. They were shown to be discharged to natural waters through municipal and industrial wastes.
Villeneuve and others (1997)		x									x						Local study to determine long term toxicity effects on stream biota from urban stormwater runoff. Fish hepatoma cells were used and exposed to water from Lincoln Creek.
Walker and others (1995)		x	x	x	x			x									Statewide study to evaluate the effectiveness of best-management practices for controlling nonpoint-source contamination. Lincoln Creek and the Menomonee River are included in the study. It discussed land use practices, rural loads, streamwater-quality, and snowmelt runoff.
Windstrup (1993)		x	x				x	x		x	x					x	Local study on Milwaukee River to create a model for predicting concentrations of heavy metals. Measurements for zinc, cadmium, chromium, lead, and copper were performed on sediment and mudflat samples. TOC, TVS, and pH were also examined.
Wisconsin Department of Natural Resources (1975b)		x												x		x	Regional supplement to a plan examining the river basins in southeastern Wisconsin. It has tables of information on industries that discharge to water resources.
Wisconsin Department of Natural Resources (1976)		x	x	x	x	x		x		x							Regional report on southeastern Wisconsin. It includes the Root River and creeks and tributaries in the area. Data from water quality sampling and an evaluation survey conducted during 1973 is presented.
Wisconsin Department of Natural Resources (1979)		x	x		x							x					Regional study on small streams including the Root River tributaries in New Berlin and Hales Corners. The major goal of the program was to provide data for the development of waste load allocations for discharges to streams. Secondly, it aimed to document the effects of increased treatment plant efficiency on stream health.
Wisconsin Department of Natural Resources (1980)	x		x	x	x			x		x				x			Local report on Little Muskego Lake describing a plan for dredging the lake and discussing the environmental impacts it would have.
Wisconsin Department of Natural Resources (1983b)	x		x	x	x												Statewide study on Wisconsin Lakes. The majority of information is recorded by region, but chloride levels are given for Little Muskego Lake.

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Wisconsin Department of Natural Resources (1983a)		x		x	x				x	x							Local study on storm water pollution in Milwaukee County. This volume examines street sweeping as well as detention and retention basins. It evaluates the costs of these measures as well as the anticipated pollution load removals.
Wisconsin Department of Natural Resources (1986)		x	x	x	x				x	x							Statewide surface water quality report based on monthly samples taken from 49 sites throughout the state. Includes sites on the Milwaukee and Kinnickinnic Rivers.
Wisconsin Department of Natural Resources (1989)		x	x		x	x		x		x	x						Report on the Milwaukee Area of Concern in the Great Lakes Basin. Menomonee, Kinnickinnic, and Milwaukee Rivers, and the Milwaukee Inner Harbor are included in the study. The purpose is to present water resource problems and what stage they are at for remediation. It presents toxics data, including those found in fish, and gives further recommendations for the Remedial Action Plan.
Wisconsin Department of Natural Resources (1990)												x				x	Local study on the Menomonee River Watershed to create a management plan. It identifies major environmental concerns and details strategies for improvement. Water resources information is given by subwatershed with information on wildlife and habitat, land use, solid and hazardous waste, and nonpoint source pollution.
Wisconsin Department of Natural Resources (1991)		x			x			x		x				x			Local study on Milwaukee River South to determine nonpoint sources of pollution to the river and recommend management actions. The most information was given for levels of phosphorus, lead, and sediments.
Wisconsin Department of Natural Resources (1992a)		x			x			x		x				x			Local study on the Menomonee River watershed. It assesses sources of water pollution and identifies management practices to be implemented. The main pollutants discussed are sediments, phosphorus, and lead.
Wisconsin Department of Natural Resources (1992b)						x					x	x		x			Statewide study to establish a database on the distribution and abundance of all fish species. It compares the 1900-1972 distributions to the studies in 1974-1986.
Wisconsin Department of Natural Resources (1992c)		x										x		x			Local study on Milwaukee River South Watershed area. The existing water quality and environmental concerns such as habitat and sewage treatment plants are described and possible water pollution causes and management strategies are outlined.
Wisconsin Department of Natural Resources (1993)	x	x			x			x		x				x			Local study on the Wind and Muskego Lakes and the tributaries leading into them. It examines nonpoint source pollution with the main focus on sediment loads.
Wisconsin Department of Natural Resources (1994)		x				x		x		x	x	x		x			Local study of Milwaukee Estuary and rivers leading into it. It identifies environmental problems and impaired uses and gives a brief overview of each. Following that are recommendations for plans to restore the water quality.

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Wisconsin Department of Natural Resources (1999)											x			x			Report for the entire Milwaukee River Basin. The purpose was to develop a public process to determine useful measurements for describing ecosystem conditions. Many possible indicators including air, water, biodiversity, and education are discussed and a little data is presented for VOCs, fish advisories, ozone, transportation, and land use.
Wisconsin Department of Natural Resources (2001)												x					Statewide study with an extensive look at the MMSD area. It contains data on sewer systems, sewer overflows, and recommendations for actions to be taken.
Wisconsin Department of Natural Resources (multiple years)		x	x	x	x	x			x		x			x			Statewide reports on water quality with some specific information on Milwaukee County and the surrounding area. They cover a variety of topics including PCBs in fish, pollution and some chemical parameters as well. There is data for the Milwaukee River, Milwaukee Estuary, Lincoln Creek, and North Avenue Dam.
Wisconsin Department of Natural Resources (multiple years)		x	x					x									Statewide study using six watersheds as study areas. This includes Milwaukee River South. The goal of the study was to determine the extent to which management practices improved fish habitat and communities.
Wisconsin Department of Natural Resources and others (1990a)		x			x			x		x				x			Local study on the Menomonee River discussing a plan for controlling nonpoint source pollution. It includes information on topics like lead, phosphorus, sediments, and erosion.
Wisconsin Department of Natural Resources and others (1990b)		x						x		x				x			Local study on Milwaukee River discussing a plan for controlling nonpoint source pollution. It includes information on toxics like lead, sedimentation, and runoff from urban and agricultural regions.
Wisconsin Department of Natural Resources and others (2001)		x			x			x	x	x		x		x			A look at the entire Milwaukee River and the streams in its basin. It includes individual descriptions of areas within the basin. There is discussion of point and nonpoint sources of pollution, wetlands, and stream and shoreline modifications.
Wisconsin Department of Natural Resources and Southeastern Wisconsin Regional Planning Commission (1985)		x	x		x			x	x								Study of the Milwaukee River watershed including rivers and tributaries that flow into it. It examines the water quality and other factors in an attempt to discern the best way to carry out an effective priority watershed program.
Wisconsin District Lake Studies Team (multiple years)	x		x	x	x					x							Statewide reports on the physical and chemical characteristics of Wisconsin lakes. The studies include Little and Big Muskego Lakes.

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Witte (1996)		x								x							Local study on the metals copper, lead, and zinc in Lincoln Creek. Data was used to assess the risk to aquatic biota from urban stormwater. However, stormwater was not found to be significant source of these metals.
Xiao and others (2001)									x								Study of the parasite Cryptosporidium and its distribution. Surface water samples were taken from locations throughout the U.S., including Lake Michigan near Milwaukee. Raw wastewater samples were also taken from Milwaukee.
Zanoni (1970)		x			x							x					Local study of the Menomonee River analyzing total soluble phosphorus concentrations throughout the year and phosphorus pound loading. Levels from agricultural lands were compared to those downstream from municipal treatment plants.

Table 1: Characteristics and description of studies pertaining to surface-water quantity and flow of the MMSD planning area.

Literature Citation (author and publication year)	Characteristics											Description	
	Lake information	Stream information	Stream discharge (flow)	Extreme flows (flood, drought)	Hydrologic budget	Erosion/sedimentation	Runoff calculations	Modeling	Precipitation/Climate	Geomorphology	Urban issues		Other
Ab Razak (1999)		x							x				Study on Milwaukee, Menomonee, and Kinnickinnic Rivers before and after the operation of the deep tunnel to determine its role in reducing pollution. Levels of phosphorus, suspended solids, fecal coliform, zinc, chloride, and BOD were examined.
Bannerman and others (1979a)		x	x						x				Local study on the combined loadings of the Menomonee, Milwaukee, and Kinnickinnic Rivers. It also examines the effects of wind-induced suspension of sediment on water quality in the Milwaukee Harbor and its vicinity.
Bannerman and others (1979b)		x	x				x		x		x		Study on the Menomonee River watershed. Water monitoring was performed to assess kinds and amounts of pollutants from land drainage of mixed and single land uses. It focuses mainly on suspended solids, phosphorus, and lead but discusses other parameters as well. It also has a section on benthic macroinvertebrate surveys.
Bannerman and others (1983a)							x				x		Local study on characteristics, sources, and management of urban storm water pollution in Milwaukee County. This volume is an executive summary of the entire study.
Bannerman and others (1983b)							x		x		x		Local study on characteristics, sources, and management of urban storm water pollution in Milwaukee County. This volume characterizes urban stormwater runoff volumes, pollutant concentrations, loadings, and water quality impacts on receiving waters. It also identified pollutant sources and examined the effectiveness of various frequencies of street sweeping.
Baun (1982)		x					x						Local study with data from the Menomonee River and Honey Creek. The article discusses three methods for estimating pollutant loads in water; integration, composite, and stratified random sampling. It gives recommendations for choosing the most effective method.
Camber (1993)		x	x										Local study on the Milwaukee River. The effect the North Shore Tunnel has on the amount of ground water seeping into and out of the river is measured.
CH2M Hill and others (2000)											x		Local plans for 24 sites in Milwaukee to prevent pollution from storm water. Directions for plans to be implemented are given. There are also lists of possible contaminants and sources for each site.
Cheetham (1973)		x				x							Regional report on erosion and sedimentation. It includes a little information on the Milwaukee River.

Table 1: Characteristics and description of studies pertaining to surface-water quantity and flow of the MMSD planning area.

Literature Citation (author and publication year)	Characteristics											Description	
	Lake information	Stream information	Stream discharge (flow)	Extreme flows (flood, drought)	Hydrologic budget	Erosion/sedimentation	Runoff calculations	Modeling	Precipitation/Climate	Geomorphology	Urban issues		Other
Cherkauer (1975a)		x					x		x		x		Local study to determine the effects of urban development on water quality in streams. Four small watersheds in different stages of development were examined in response to the same meteorological events. Total dissolved solids and chloride loads were examined.
Cherkauer (1975b)		x	x								x		Local study on two small watersheds in the Milwaukee area. One was urban and the other an agricultural watershed. Flow and pollutant loads were compared between the two after a rainfall.
Christensen and Lo (1986)					x								Local study on Milwaukee Harbor. A sediment core was taken from the inner harbor, dated, and analyzed for PCBs. The results were compared with Lake Michigan information. Concentrations were shown to correlate to sales records of PCBs.
City of Milwaukee Wisconsin Department of Public Works and others (1974)		x					x	x	x				Local study looking at effectiveness of detention tanks in preventing combined sewer overflows. Five years of data and modeling studies were done on Milwaukee River in which the water quality was examined in relation to rainfall.
City of Milwaukee Wisconsin Department of Public Works and others (1975)		x	x				x	x	x				Local evaluation of a combined sewer overflow detention tank in Milwaukee. Based on modeling studies and data from sewer and river monitoring, detention tanks were shown to prevent combined sewer overflow contaminants from reaching receiving waters.
Conger (1971)		x	x	x					x				Statewide study to provide a way to estimate flood characteristics. Basin characteristics were used in the equations. Data was collected from gaging stations for rivers across the state. This included the Milwaukee, Little Menomonee, and Menomonee Rivers, and Honey and Oak Creeks.
Conger (1986)		x	x	x			x	x	x		x		Statewide study to develop equations to estimate the magnitude and frequency of flooding at ungaged urban sites. Land use was examined and data from gauged sites in six Wisconsin cities, including Milwaukee, was used.
DeVita (1994)		x	x										Local study on Lincoln Creek. It evaluates semipermeable polymeric membrane devices as concentrators of nonpolar organic contaminants, namely PAHs. Concentration levels are related to storm events. Uptake by fathead minnows and rusty crayfish were also examined.
Dong and others (1979)		x	x			x							Study on the Menomonee River watershed. Metal composition in sand-, silt-, and clay-sized fractions of soil types, bottom sediments, suspended sediments, and dust and dirt samples were analyzed. A method for estimating soil dispersibility was also developed.

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	Lake information	Stream information	Stream discharge (flow)	Extreme flows (flood, drought)	Hydrologic budget	Erosion/sedimentation	Runoff calculations	Modeling	Precipitation/Climate	Geomorphology	Urban issues	
Dong and others (1983a)					x							Local study on the Menomonee River watershed. Soil samples were taken and dispersed by shaking to simulate water erosion and particle transport conditions. After that, they were completely dispersed with ultrasound. The information gathered was used to measure ease of dispersibility of soils based on clay-sized particle content.
Dong and others (1984)		x	x		x							Study on the Menomonee River watershed. Phosphorus levels were compared with particle size of soils, street dust, and bottom- and suspended-sediments. Attempts were made to identify phosphorus sources by particle size composition.
Druckenmiller (1980)	x				x		x		x			Local Environmental Impact Statement from a plan to dredge Little Muskego Lake. They hoped to improve aquatic life, aesthetic qualities, and recreational uses by deepening shallow areas and controlling macrophyte growth.
Fitzpatrick and Giddings (1997)		x	x							x		Regional study on the Western Lake Michigan Drainages with sites on Lincoln Creek and the Milwaukee River. The sites were evaluated for stream habitat. Channel geometry, substrate, streambank and riparian characteristics were examined.
Gergerich (1978)		x							x			Local study on Milwaukee and Menomonee Rivers to show the relationship of bacteriolytic organisms with fecally polluted waters. Their presence was compared with levels of sewage-indicator bacteria and abundance was examined in relation to temperature and rainfall.
Graczyk (1993)		x	x				x		x			Statewide study on nonpoint source pollution. It discusses rainfall, water-quality, bedload, metals, DO, total- and dissolved hardness, and quality control. Data on precipitation and storm water runoff is given for the Menomonee River.
Great Lakes Commission (2000)		x	x									Multi-state review of Lake Michigan basin and subwatersheds, one of which is the Milwaukee River and Estuary. Discusses monitoring that is being done and recommendations for further actions that are needed.
Hajda (1993)		x	x					x				Local study on Milwaukee River to estimate the impact of the removal of the North Avenue Dam by using a mathematical model. Data was given for levels of ammonia, nitrate, inorganic and organic phosphorus, chlorophyll-a, BOD, DO, organic nitrogen and discharge.
Hansen and others (1983)		x	x				x	x	x		x	Local study on storm water pollution in Milwaukee County. This volume presents the procedures used for the field monitoring data in volumes one and two. It also describes the sites that were examined in the study.

Table 1: Characteristics and description of studies pertaining to surface-water quantity and flow of the MMSD planning area.

Literature Citation (author and publication year)	Characteristics												Description
	Lake information	Stream information	Stream discharge (flow)	Extreme flows (flood, drought)	Hydrologic budget	Erosion/sedimentation	Runoff calculations	Modeling	Precipitation/Climate	Geomorphology	Urban issues	Other	
Harsch (1972)		x	x						x				Collection of papers concerning the Menomonee River. Section A contains scientific investigations and research data. Section B examines sociological and economic problems of pollution and examinations of types of abatement.
Harza Engineering Company (2001)		x								x			Local study on sites on the Menomonee River, Lincoln Creek and Southbranch Creek. The goal was to determine whether removal of concrete channel lining significantly improves stream habitat. To do so they provided MMSD with data and recommended methodology to evaluate stream characteristics.
Holmstrom (1982)		x	x	x				x	x				Regional study to form mathematical equations to estimate low flow in streams using data from gaged stations. Drainage area and base flow index were also taken into account.
House (1987)			x					x					Local study on Milwaukee Harbor using an unsteady-flow model. The model uses channel-geometry discharge at upstream tributaries and stage data at the estuary mouth to determine flow.
Jodie (1974)							x		x				Local study of stormwater runoff taken from two urban freeways in Milwaukee. The samples were shown to be of poor water quality after compared to samples from Jones Island Sewerage Treatment Plant, the Menomonee River, other stormwater data, and standards for Wisconsin.
Johanson (1990)		x	x										Local study on the Milwaukee River and the Blue Hole abandoned landfill. The purpose was to define the hydrogeology and contaminant distribution in the landfill and to determine the effects of ground water from the Blue Hole site on the water quality of the Milwaukee River.
Kincaid (1981)							x		x				Local study on acid rain and its sources and effects in Milwaukee. Runoff is also evaluated with data on pH and other chemical parameters.
Konrad and others (1978)		x				x				x			Local study on Menomonee River watershed. They examined land use, phosphorus, lead, and suspended solids data to create a model to describe the washoff of pollutants from land surfaces.
Konrad and others (1979)		x	x					x			x		Local study describing ground-water impacts on the quality of the Menomonee River. Loading rates are quantified and major contaminants and sources are identified. A predictive model was tested to measure groundwater response to changes in land use or management practices.
Krug and others (1992)		x	x	x					x				Statewide study on flood-frequency characteristics of Wisconsin streams. Drainage basin characteristics were analyzed.
Lawrence and Ellefson (1982)			x								x		Statewide report on water uses in Wisconsin. For each county it tells how many gallons of ground water or surface water is used and whether it is for residential, industrial, commercial, irrigation, or stock purposes. It also tells which rivers were used for hydroelectric and thermoelectric power.

Table 1: Characteristics and description of studies pertaining to surface-water quantity and flow of the MMSD planning area.

Literature Citation (author and publication year)	Characteristics											Description
	Lake information	Stream information	Stream discharge (flow)	Extreme flows (flood, drought)	Hydrologic budget	Erosion/sedimentation	Runoff calculations	Modeling	Precipitation/Climate	Geomorphology	Urban issues	
Lee (1997)		x								x	x	Local study on the quantity of seepage from the Deep Tunnel to the Milwaukee River. Also studied was the effect on seepage by the Milwaukee Formation, a dolomite of low hydraulic conductivity.
Lenz and Rheume (2000)		x	x									Regional study of the Western Lake Michigan Drainages. Lincoln Creek and Milwaukee River are included in the study. Distribution and community structure of benthic invertebrates is discussed and used as water quality indicators. Environmental setting and habitat are also examined.
Li and others (1998)		x				x						Local study on the Milwaukee Harbor Estuary. Sediment samples were analyzed for PAHs. Grain size, porosity, and total organic carbon were also determined. The results overview the impact of industrialization in the Milwaukee area.
Masterson and Bannerman (1994)		x	x									Local study on rivers and creeks in Milwaukee County. Chemical analysis was performed on sediment, fish, crayfish tissue, and water samples to determine the effects of stormwater runoff. Bioaccumulation was examined and an index of biotic integrity for macroinvertebrates was performed.
Meinholz and others (1979)		x	x						x			Local study on the impacts on the Milwaukee River following wet weather discharges. DO concentrations and fecal coliform were monitored in relation to flow. Other chemical characteristics were also examined.
Mildner (1978)		x				x				x		Multi-state study to evaluate the effect of material eroded from riverbanks on water quality of the Great Lakes. Riverbank protection measures and costs were determined. The Menomonee River and Germantown watershed were used as study sites.
Miller and others (1992)		x				x						Local study on the Root River. The results are discussed in relation to the objectives of the 1980 Root River Nonpoint Source Water Pollution Plan to determine if the goals of the plan are being achieved.
Milwaukee Metropolitan Sewerage District		x		x					x	x	x	Local study on the Menomonee River and its tributaries. It summarizes problems and recommendations for flood management. It is an update on the progress of MMSD's 1990 Watercourse System Plan.
Milwaukee Metropolitan Sewerage District (1976)									x		x	Description of MMSD's Master Facilities plan designed to reduce water pollution. It includes an analysis of alternate solutions and an explanation of the pollution problems and their causes.
Milwaukee Metropolitan Sewerage District (1980a)			x	x					x			Report on a plan for combined sewer overflow abatement. It examines environmental impacts on the Milwaukee, Menomonee, and Kinnickinnic Rivers.
Milwaukee Metropolitan Sewerage District (1980c)		x	x						x			Report on Franklin - Northeast Interceptor Facility plan. It examines the status of the Root River and the effects the proposed plan will have on it.

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	Lake information	Stream information	Stream discharge (flow)	Extreme flows (flood, drought)	Hydrologic budget	Erosion/sedimentation	Runoff calculations	Modeling	Precipitation/Climate	Geomorphology	Urban issues	
Milwaukee Metropolitan Sewerage District (1980d)			x									Local plan for Jones Island Facility. It discusses existing environmental status and the impacts the plan will have on Milwaukee's Harbor and it also includes some information on the tributaries leading into the harbor.
Milwaukee Metropolitan Sewerage District (1980e)		x	x						x			Report on the Mitchell Field South Interceptor Facility plan. It examines the status of water in Mitchell Field Ditch and in Oak Creek and states the effects the plan will have on it.
Milwaukee Metropolitan Sewerage District (1980f)			x						x			Local plan for water pollution abatement facilities. It discusses existing and future conditions affecting water quality in the area.
Milwaukee Metropolitan Sewerage District (1980g)		x	x						x		x	Local plan for the Northridge Interceptor Facility with an environmental assessment on Beaver Creek, Trinity Creek, and the Milwaukee River. It examines land use and physio-chemical characteristics.
Milwaukee Metropolitan Sewerage District (1980h)		x	x						x			Report on the Oak Creek North Branch Interceptor Facility plan. It examines the status of Oak Creek and states the effects the plan will have on it.
Milwaukee Metropolitan Sewerage District (1980j)		x	x						x		x	Local plan for MMSD's Underwood Creek Interceptor Facility with an environmental assessment on Underwood Creek, Dousman Ditch, and the Menomonee River. It discusses land use, some point sources of pollution and physio-chemical characteristics.
Milwaukee Metropolitan Sewerage District (1982)		x	x	x								Local reports prepared for MMSD's Water Pollution Abatement Program. It evaluates and refines the 1980 Master Facilities Plan and includes an environmental assessment.
Morawski (1999)		x	x	x				x			x	Local study on Oak Creek using computer modeling to calculate flood risk. Land use and weather conditions are taken into account.
Morrissey (2000)		x	x	x			x	x	x	x		Local study on Underwood Creek of an area prone to flooding. Modeling techniques are used to estimate stormwater hydrographs and assess the effects a detention basin may have on discharge.
Novotny (1986)							x	x	x		x	Local study on the Milwaukee to develop a snowmelt runoff model. It can be used to predict snow accumulation and melt in urban areas. It looks at accumulation of pollutants in snow, flow rates, and above all, use of deicing chemicals. A model was used to simulate chloride concentrations and flow.
Novotny and Bendoricchio (1989)		x	x									Local study with information on the Menomonee River watershed and some of the tributaries and creeks within the watershed. The model LANDRUN was used for estimating sediment loadings from various land uses and other factors like soil characteristics and imperviousness. Phosphorus loadings were also examined.

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Novotny and others (1979a)		x					x	x	x		x		Study on Milwaukee River and the canals of Venice. It examines nonpoint source pollution and looks at problems associated with excess nutrients: its relationship with productivity and oxygen demand. It has some data on dissolved oxygen, nitrogen , and chlorophyll-a levels from the MMSD.
Novotny and others (1979b)		x	x				x	x	x		x		Local study using LANDRUN, a model used to estimate the quantity and quality of runoff water and eroded particulates from watershed with mixed land uses. Runoff, sediment, volatile suspended solids, and phosphate data from Novey Creek, Schoonmaker Creek, and the Little Menomonee River were used to calibrate the model.
Novotny and others (1994)		x				x							Local study of the North Avenue urban impoundment on the Milwaukee River. A model was used to simulate water and sediment quality in areas contaminated by toxic metals.
Nowak (1995)		x							x	x	x		Local look into a court case regarding the concrete lining that was put into Crayfish Creek in the city of Oak Creek, WI.
Owens and others (1997)		x	x						x				Statewide evaluation of nonpoint source contamination and management practices. Lincoln Creek and Milwaukee River were included in the study. Data was given for precipitation, flow, suspended solids, phosphorus, and metals.
Parker and others (1970)		x		x								x	Local study on the Root River Watershed. It investigates the relationship of areas subject to flooding to detailed soil maps in order to predict floodplain boundaries in glaciated landscapes.
Peters (1997)		x	x	x			x		x				Regional study on Western Lake Michigan Drainages. It is a compilation of articles on natural and anthropogenic features of the area that have an impact on water quality. These include geology, climate, vegetation, land use, and hydrologic and biological characteristics.
Port of Milwaukee (1995)		x				x				x			Local study on the Milwaukee, Kinnickinnic, and Menomonee Rivers, and the South Menomonee and Burnham Canals. It discusses problems concerning erosion, dock walls, and land use. Shoreline and streambank protection measures are presented.
R.A. Smith & Associates Inc. and others (1996)		x		x						x	x		Local study on the Menomonee River. It evaluates the potential of returning it to a more natural state and improving recreational access. Some of the proposed ideas were creating a wetland, making a trail, and removing the concrete lining.
Richards (1990)		x	x										Study on tributaries to the Great Lakes in Canada and the United States, including the Milwaukee River. Since pollutant concentration data is lacking for many rivers, the flux rates were looked at in terms of flow. Tributaries were classified based on flow variability and responsiveness.

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Richards and others (1998)		x	x						x				Regional study of Wisconsin streams in the Lake Michigan Drainage Basin. The study includes the Milwaukee River and Lincoln Creek and describes techniques used to collect water samples and methods for analysis. It discusses the effects of some factors on water quality, such as climate, bedrock, and land use.
Robertson (1997)		x	x	x									Regional study on tributaries to Lake Michigan and Lake Superior, including the Milwaukee River. Suspended sediment and phosphorus loads were estimated for unmonitored locations using data from monitored sites, especially during high flows. Stream gradient, land use, and soil type were also examined.
Robertson (1998)		x	x							x			Regional study of the Western Lake Michigan Drainages. It includes Lincoln Creek, Little Menomonee River, Honey Creek, Oak Creek, and the Kinnickinnic River. Streamflow, nutrients, and suspended sediment data was used to look at the effects on water-quality by land use, surficial deposits, and bedrock type.
Robertson and Saad (1996)		x	x						x	x			Regional study of the Western Lake Michigan Drainages on ground-water and surface-water resources, including the Milwaukee River. It contains data for nutrient and suspended sediment levels. This information is related to land use and other geologic characteristics, and it assesses streams and discusses implications for future sampling.
Rose (1978)				x					x	x			Local geologic study of the soils adjacent to the Milwaukee, Menomonee, and Kinnickinnic Rivers for foundation construction. It includes some information about climate and flooding.
Southeastern Regional Planning Commission (1976)		x	x	x		x		x	x	x	x		Local study on the Menomonee River watershed to provide a plan that will work on the flooding problems and increase the health of the river and its use as a habitat. Physical description of the area is given along with wildlife that is found there. Data for flooding and surface water monitoring is also given.
Southeastern Regional Planning Commission (1978b)		x	x	x		x	x	x	x	x	x		Local study on the Kinnickinnic River watershed to choose a plan that will assist in decreasing flood risk and water pollution. Physical description of the area is given along with flooding and surface water monitoring data.
Southeastern Wisconsin Regional Planning Commission (1986c)		x	x	x		x	x	x	x	x	x		Local study on the Oak Creek watershed to provide a plan that will address flooding problems and increase the health of the river and its use as a habitat. A physical description of the area is given along with wildlife that is found there. Data for flooding and surface water monitoring is also given.
Southeastern Wisconsin Regional Planning Commission (1987a)		x	x				x		x	x			Local study on the Milwaukee Harbor Estuary which involves the Milwaukee, Menomonee, and Kinnickinnic Rivers, and the Harbor. The purpose was to prepare a plan that will assist in controlling pollution, mitigate flood problems, control storm damage in the harbor, and improve water quality for recreational uses. Monitoring data is given.

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Southeastern Wisconsin Regional Planning Commission (1979)		x	x							x			Local study on the Oak Creek Watershed which also includes the Mitchell Field Drainage Ditch. Existing water quality was evaluated as they formed a program to address flooding, water pollution and other related problems.
Southeastern Wisconsin Regional Planning Commission (1980)		x				x				x			Loacal study on the Root River and its tributaries. This plan is for the control of pollution of both urban and rural sources.
Southeastern Wisconsin Regional Planning Commission (1971)		x	x	x					x	x	x		Regional study on the Milwaukee River to show the need for comprehensive planning for program design and implementation. It discusses existing water conditions and problems and gives possible solutions. Topics covered include flooding, water quality, water supply, and recreation.
Southeastern Wisconsin Regional Planning Commission (1974)		x		x									Local study on the Kinnickinnic River watershed. The purpose is to show the need for a comprehensive watershed planning program to reduce pollution and flooding.
Southeastern Wisconsin Regional Planning Commission (1978c)		x							x				Regional study on the Lake Michigan Drainage Area in Southeastern Wisconsin. The purpose is to show the need for, the major elements, and the organizations of a comprehensive planning program. It has information on the Root River and the Milwaukee Harbor Estuary.
Southeastern Wisconsin Regional Planning Commission (1978d)		x	x				x				x		Regional study of point and nonpoint source water pollution in Southeast Wisconsin. It gives nitrogen, phosphorus, BOD, sediment, and fecal coliform loads from urban and rural sources to different bodies of water.
Southeastern Wisconsin Regional Planning Commission (1978e)		x	x										Regional study of lakes and streams in southeastern Wisconsin. Included in the report is data on the Milwaukee, Root, Menomonee, and Kinnickinnic Rivers, and Oak Creek.
Southeastern Wisconsin Regional Planning Commission (1982)		x		x			x	x		x			Local study on flooding of Lincoln Creek. It discusses the various plans to control it. The final recommendation was to restructure the bed of the creek.
Southeastern Wisconsin Regional Planning Commission (1986a)		x		x						x			Examination of all the rivers that flow through the MMSD area. It looks for improvements for flood control and examines floodlands along the streams.

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Southeastern Wisconsin Regional Planning Commission (1986b)				x		x	x		x		x		Local plan for managing stormwater in Hales Corners, WI. It discusses the effect of precipitation and increased urbanization on runoff.
Southeastern Wisconsin Regional Planning Commission (1988a)		x		x							x		Local description of flooding and stormwater drainage problems of Crayfish Creek subwatershed. It identifies causes of the problems and provides evaluations of proposed solutions.
Southeastern Wisconsin Regional Planning Commission (1988b)						x					x		Regional report on conference proceedings discussing achieving water quality through land management. Issues addressed included erosion control, stormwater management, nonpoint source water pollution, environmental corridors, floodplains, and wetlands.
Southeastern Wisconsin Regional Planning Commission (1989)		x		x									Local study on flood control for the Menomonee River Estuary. It identifies areas prone to floods and damage. An examination of possible solutions and a final selection of a plan is included.
Southeastern Wisconsin Regional Planning Commission (1990)		x	x	x						x			Local plan for the area of MMSD for stormwater drainage and flood control. Alternative and proposed plans are given for each of the following watersheds; Kinnickinnic River, Lake Michigan Direct Drainage Area, Oak Creek, Root River, Milwaukee River, and Menomonee River.
Southeastern Wisconsin Regional Planning Commission (1992)		x		x									Local study on Grantosa Creek, a tributary to the Menomonee River. Problems with flooding are discussed and flood control plans are evaluated.
Southeastern Wisconsin Regional Planning Commission (1993)		x							x	x	x		Local plan for flood and stormwater management for Lilly Creek subwatershed. Evaluates alternative plans in hopes to eliminate current problems and avoid future ones while also considering nonpoint source pollution and river habitat.
Southeastern Wisconsin Regional Planning Commission and others (2000)							x		x		x		Local study on Dousman Ditch and Underwood Creed subwatershed of the Menomonee River watershed. It identifies stormwater management and flooding problems and their causes. It also sets forth a management plan after examining alternatives.
Sullivan and others (1995)		x	x							x			Regional study on the Western Lake Michigan Drainages. Lincoln Creek and the Milwaukee River are included in the study. Data is given for land use, physical characteristics of the streams, and field measurements.
Sung (1983)						x	x	x			x		Study on eight watersheds in Milwaukee county to estimate nonpoint pollution and identify its sources. A model was created to help design urban nonpoint source control programs.

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Taylor (1994)		x				x	x		x		x		Local study on the Kinnickinnic River examining nonpoint sources of pollution. Urban runoff and erosion from construction sites and streambanks are the main issues.
Toyingtrakoon (1996)		x	x						x				Local study on the Milwaukee, Menomonee, and Kinnickinnic Rivers and the Jones Island wastewater treatment facility to determine the impacts of the deep tunnel. Measurements included levels of phosphorus, BOD, fecal coliform, and suspended solids after precipitation.
U.S. Enviromental Protection Agency and others (1980b)		x	x										Local study of MMSD area addressing the proposed Master Facilities Plan. It concentrates on the issue of overflows due to infiltration of ground water and storm water. They discuss current water quality and how the plan will affect it.
U.S. Environmental Protection Agency (1980a)			x										Local study addressing MMSD’s Master Facilities Plan. It analyzes what the proposed actions and alternatives would have on the environment and the existing water quality. It includes data levels for ammonia, nitrogen, phosphorus, BOD, pH, flow, fecal coliform, and chlorine.
Walesh and others (1979)						x			x	x	x		Local study on the impacts of land use on water quality in the Menomonee River Watershed. It discusses methods for obtaining land cover information. The watershed is described and climate, soil, geology, land use, imperviousness, and erosion potential are examined.
Wisconsin Department of Agriculture, Trade, and Consumer Protection Soil and Water Resource Management Program and others (1991)						x							Statewide update on the progress of Soil and Water Resource Management Goals. It takes a look at erosion and phosphorus levels mostly due to agriculture runoff.
Wisconsin Department of Natural Resources (1976)		x	x	x					x				Regional report on southeastern Wisconsin. It includes the Root River and creeks and tributaries in the area. Data from water quality sampling and an evaluation survey conducted during 1973 is presented.
Wisconsin Department of Natural Resources (1979)		x	x										Regional study on small streams including the Root River tributaries in New Berlin and Hales Corners. The major goal of the program was to provide data for the development of waste load allocations for discharges to streams. Secondly, it aimed to document the effects of increased treatment plant efficiency on stream health.
Wisconsin Department of Natural Resources (1980)	x				x		x		x	x			Local study on Little Muskego Lake. It is an Environmental Impact statement of a project to rehabilitate the lake for control of macrophyte growths, improved aquatic habitat, and recreation and aesthetic qualities. The plan includes dredging the lake.

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Wisconsin Department of Natural Resources (1983a)		x	x				x				x		Local study on storm water pollution in Milwaukee County. This volume examines street sweeping as well as detention and retention basins. It evaluates the costs of these measures as well as the anticipated pollution load removals.
Wisconsin Department of Natural Resources (1992a)		x				x					x		Local study on the Menomonee River watershed. It assesses sources of water pollution and identifies management practices to be implemented. The main pollutants discussed are sediments, phosphorus, and lead.
Wisconsin Department of Natural Resources (1992c)		x								x			Local study on Milwaukee River South Watershed area. The existing water quality and environmental concerns such as habitat and sewage treatment plants are described and possible water pollution causes and management strategies are outlined.
Wisconsin Department of Natural Resources (1993)		x				x							Local study on Wind and Muskego Lakes and the tributaries leading into them. It examines nonpoint source pollution with the main focus on sediment loads.
Wisconsin Department of Natural Resources (1994)		x				x	x				x		Local study of the Milwaukee Estuary and rivers leading into it. It identifies environmental problems and impaired uses and gives a brief overview of each. Following that are recommendations for plans to restore the water quality.
Wisconsin Department of Natural Resources (multiple years)		x	x							x			Statewide study using six watersheds as study areas. This includes Milwaukee River South. The goal of the study was to determine the extent to which management practices improved fish habitat and communities.
Wisconsin Department of Natural Resources and others (1990a)		x				x					x		Local study on the Menomonee River discussing a plan for controlling nonpoint source pollution. It includes information on topics like lead, phosphorus, sediments, and erosion.
Wisconsin Department of Natural Resources and others (1990b)		x				x					x		Local study on Milwaukee River discussing a plan for controlling nonpoint source pollution. Includes information on toxics like lead, sedimentation, and runoff from urban and agricultural regions.
Wisconsin Department of Natural Resources (1991)		x				x					x		Local study on Milwaukee River South to determine nonpoint sources of pollution to the river and recommend management actions. The most information was given for levels of phosphorus, lead, and sediments.
Wisconsin Department of Natural Resources and others (2001)		x					x				x		A look at entire Milwaukee River and the streams in its basin. It includes individual descriptions of areas within the basin, discussion of point and nonpoint sources of pollution, wetlands, and stream and shoreline modifications.

Table 1: Characteristics and description of studies pertaining to ecology of the MMSD planning area.

Literature Citation (author and publication year)	Characteristics																			Description		
	Lake information	Stream information	Fish	Macroinvertebrates	Algae/Macrophytes	Amphibians/reptiles	Birds	Mussels	Wildlife	Toxic bioassays	Endangered/Threatened species	Tolerant/Intolerant species	Non-native/Invader species	Habitat	Wetlands	Human effects/urban issues	Community surveys	Management issues	Water quality interpretations based on ecology		Biotic Index Values	Other
Amin and others (1973)		x	x											x							x	Local study on fish taken from the Root River from sites in Milwaukee and Racine counties. The fish were examined for infestation by the copepod <i>Lernaea cyprina</i> - <i>cea</i> . Location and frequency of infestation is discussed in relation to fish body size and stream conditions.
Anderson (1975)	x				x													x				Statewide classification of lakes by trophic condition. Most lakes examined were 100 acres or larger. Big and Little Muskego Lakes were in the study. It also discusses lake protection and rehabilitation procedures, classification and management programs.
Anderson (2001)		x	x	x															x	x		Local study of the Menomonee River and Oak creek to determine water quality. An index of biotic integrity for fish composition and a family biotic index and a multimetric comparison for macroinvertebrates were used.
Auer (1982)			x																			Multi-state study of the Great Lakes region with emphasis on Lake Michigan drainages. It has ecological information on larval fishes and illustrations for identification.
Bacon and others (1995)							x															Statewide study on duck and geese populations and the amount of wetlands available for habitat. Information is given by region.
Bannerman and others (1979b)		x		x												x			x	x		Study on the Menomonee River watershed. Water monitoring was performed to assess kinds and amounts of pollutants from land drainage of mixed and single land uses. It focuses mainly on suspended solids, phosphorus, and lead but discusses other parameters as well. It also has a section on benthic macroinvertebrate surveys.
Becker (1976)			x																			Multi-state examination of fish in the Lake Michigan region. It contains distribution maps and a description for each species.
Becker and Johnson (1970)			x																			Statewide study on minnows in Wisconsin. Contains a key for identification and includes illustrations. There are also some notes on minnow abundance and distribution.

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Bothwell (1977)					x																	Local study of the Milwaukee Harbor and near-shore Lake Michigan. It had a station at the confluence of the Milwaukee and Kinnickinnic Rivers. It investigates phytoplankton populations in relation to nutrients. Other factors such as temperature, chloride, and alkalinity are also examined.
Boyer (1988)				x																		Local study on Milwaukee Harbor at the sediment water interface. Sediment-profile photographs were taken to map sediment type. Gas voids and oligochaete worm tubes are also shown.
Brynildson (1980)			x			x		x			x											Statewide study on endangered reptiles, fish, and molluscs. It has descriptions of 14 species and their distributions.
Casper (1996)						x																Statewide study on amphibian and reptile distribution. It contains distribution maps for each species.
Cumming and Mayer (1992)								x														Multi-state information on freshwater mussels. There is a one page description of each with colored picture and distribution map.
DeVault (1985)		x	x																			Multi-state study of tributaries to the Great Lakes with the Milwaukee and Kinnickinnic Rivers included in the study. Fish samples were analyzed for contamination from pesticides and other priority pollutants including PCBs and PAHs.
DeVita (1994)		x	x	x																		Local study on Lincoln Creek. It evaluates semipermeable polymeric membrane devices as concentrators of nonpolar organic contaminants, namely PAHs. Concentration levels are compared in relation to storm events. Uptake by fathead minnows and rusty crayfish was also examined.
Druckenmiller (1980)	x		x		x									x				x				Local Environmental Impact Statement from a plan to dredge Little Muskego Lake. They hoped to improve aquatic life, aesthetic qualities, and recreational uses by deepening shallow areas and controlling macrophyte growth.
Eggers and Reed (1988)					x										x							Multi-state guide to wetland plant communities. Plants are grouped by type of wetland they are found in ranging from open water to seasonally flooded basins.
Emmling (1976)				x										x								Local study on the Milwaukee Harbor and its tributaries. Macroinvertebrate distributions were compared to the type of sediment present.

Table 1: Characteristics and description of studies pertaining to ecology of the MMSD planning area.

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	Lake information	Stream information	Fish	Macroinvertebrates	Algae/Macrophytes	Amphibians/reptiles	Birds	Mussels	Wildlife	Toxic bioassays	Endangered/Threatened species	Tolerant/Intolerant species	Non-native/Invader species	Habitat	Wetlands	Human effects/urban issues	Community surveys	Management issues	Water quality interpretations based on ecology	Biotic Index Values		Other
Fago (1984)		x	x								x											Regional study in southeastern Wisconsin. It examines fish populations and contains distribution maps. It also talks about some species that are threatened or on a watch list.
Fitzpatrick and Giddings (1997)		x												x		x						Regional study on the Western Lake Michigan Drainages with sites on Lincoln Creek and the Milwaukee River. The sites were evaluated for stream habitat. Channel geometry, substrate, streambank and riparian characteristics were examined.
Fox (1971)																		x				Statewide examination of water resources policies and issues involved in a metropolitan region. The southeast region of Wisconsin, including Milwaukee, was selected for study. Wastewater treatment and flooding are discussed.
Gerber (1994)					x									x								Study in Wisconsin and Michigan of the genus <i>Myriophyllum</i> (Water Millfoil Family). The goals of the study were to characterize habitats and see if there was a relationship with leaf shape and size or nutrient uptake with the habitat. Sites of nutrient uptake were also examined.
Great Lakes Commission (2000)		x	x	x					x													Multi-state review of the Lake Michigan basin and subwatersheds, one of which is the Milwaukee River and Estuary. Discusses monitoring that is being done and recommendations for further actions that are needed.
Harding (1997)						x																Regional guide to the reptiles and amphibians of the Great Lakes region. Habitat, ecology, reproduction, and conservation issues are discussed. Descriptions and photographs are given along with information on distribution and abundance.
Harsch (1972)		x			x																	Collection of papers concerning the Menomonee River. Section A contains scientific investigations and research data. Section B examines sociological and economic problems of pollution and examinations of types of abatement.
Harza Engineering Company (2001)		x	x	x										x				x				Local study on sites on the Menomonee River, Lincoln Creek and Southbranch Creek. The goal was to determine whether removal of concrete channel lining significantly improves stream habitat. To do so they provided MMSD with data and recommended methodology to evaluate stream characteristics.
Hausmann (1974)				x																		Local study on macroinvertebrate populations in Milwaukee Harbor and Lake Michigan with one sample site on the Milwaukee River. Results were compared to previous findings; they found a decline in many species.

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Hine and others (1981)						x																Statewide study of Leopard Frog distributions with data from 1974-76. There is an in-depth study of East Central Wisconsin, and there is information for the rest of the state by region.
Hobbs and Jass (1988)				x																		Statewide study on the crayfish and shrimp of Wisconsin. Ecological and life history information is given about each species along with a key for identification. Distribution maps are also included.
Hunt (1990)		x	x											x				x				Statewide study including the Kinnickinnic River. Brown Trout size and populations are examined in response to habitat improvement techniques.
Inskip (1986)			x																			Statewide study on the occurrence of Muskellunge and Northern Pike. It discusses the effects on populations of these species due to their interaction with each other.
Kaemmerer and others (1992)		x	x						x							x						Local study looking at the Milwaukee Harbor and parts of the Milwaukee, Menomonee, and Kinnickinnic Rivers. It discusses the biological problems with the area and tells how various agencies and groups are trying to address them.
Kasun (2001)		x		x																		Local study on Oak Creek and the Menomonee River. The objective of the research was to predict the bioavailable concentrations of heavy metals in interstitial porewater and examine the ecological risk by looking at benthic macroinvertebrates.
Kleinert and Degurse (1972)	x	x	x						x													Statewide study of mercury concentrations in Wisconsin fish and wildlife. Includes fish from Milwaukee River and Milwaukee Harbor.
Kleinert and others (1974)	x	x	x																			Statewide examination of toxic metal concentrations in fish. Fish from the Milwaukee River were included in the study. They were tested for arsenic, cadmium, chromium, lead, and zinc.
Kohler (1982)	x			x	x																	Local study on Big Muskego Lake examining the phytoplankton population. It was examined to see how it was affected by biological and phsio-chemical factors such as nitrogen, phosphorus, pH, DO, and zooplankton.
Korth (1978)		x			x																	Local study on the Milwaukee River to determine the effect that algae has on the sediment oxygen demand. It was not shown to be a significant source.

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Lee and others (1981)				x																		Local study on biological and chemical water quality in Milwaukee Harbor and Lake Michigan. It determines the mixing and transport of MMSD effluent plumes. Indicator bacteria and viruses are also investigated.
Legler and others (1998)																					x	Statewide examination of dragonflies. It provides colored pictures for identification and maps of their distributions.
Lenz and Rheume (2000)		x		x										x						x	x	Regional study of the Western Lake Michigan Drainages. Lincoln Creek and Milwaukee River are included in the study. Distribution and community structure of benthic invertebrates is discussed and used as water quality indicators. Environmental setting and habitat are also examined.
Lueschow (1972)	x	x			x													x				Statewide study on algae and macrophyte control. It also examines control of swimmers itch. A table lists chemical treatments used in bodies of water including Little Muskego Lake and the Milwaukee river.
Lyons (1989)		x	x											x								Statewide study to see if fish assemblage distribution corresponded to Omernik's ecoregions. Characteristics are given for each of the four regions that cover most of Wisconsin. Temperature, gradient, substrate, and shoreline vegetation are shown to be better predictors than geographic location.
Lyons (1992a)		x	x																			Study on nine streams in southern Wisconsin to determine the length that a sampling station should be for sampling fish. The Menomonee River was one of the sampling sites.
Lyons (1992b)		x	x									x								x	x	Statewide study for developing a version of the Index of Biotic Integrity (IBI) for Wisconsin warmwater streams. It describes how the IBI for fish should be applied and interpreted. The appendix contains IBI scores for various rivers including the Milwaukee and Menomonee. There are also other water quality scores (EQ, HQ, and WQ).
Lyons and Kanehl (1993)		x	x																			Statewide comparison of smallmouth bass sampling methods. Sites across the state were studied including the Milwaukee River. Guidelines are provided for estimating abundances in shallow wadable streams.

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Mace (1984)		x			x												Regional study on southern Wisconsin streams for setting appropriate water quality goals or standards for amounts of phosphorus. Milwaukee River is included in the study. Nutrient levels were compared to macrophyte and algal growth and its effect on DO concentrations was examined.
Martin and others (1983)	x				x												Statewide examination of Wisconsin Lakes. The trophic condition of about 3000 inland lakes were assessed using landsat satellite data. Waterbodies from Ozaukee, Washington, and Waukesha Counties were included in the study.
Masterson and Bannerman (1994)		x	x	x										x			Local study on rivers and creeks in Milwaukee County. Chemical analysis was performed on sediment, fish, crayfish tissue, and water samples to determine the effects of stormwater runoff. Bioaccumulation was examined and an index of biotic integrity for macroinvertebrates was performed.
Mathiak (1979)		x						x									Statewide study on mussels found in rivers. It describes each mussel, contains color photographs, and distribution maps.
Miller and others (1992)		x	x	x												x	Local study on the Root River. The results are discussed in relation to the objectives of the 1980 Root River Nonpoint Source Water Pollution Plan to determine if the goals of the plan are being achieved.
Milwaukee Metropolitan Sewerage District (1980a)		x	x	x								x					Report on a plan for combined sewer overflow abatement. It examines environmental impacts on the Milwaukee, Menomonee, and Kinnickinnic Rivers.
Milwaukee Metropolitan Sewerage District (1980b)		x				x	x		x			x					Report on a plan for Franklin-Muskego Interceptor Facility. It includes environmental assessment with information on Little Muskego Lake, Big Muskego Lake, Little Muskego Creek, Tess Corners Creek, and the Root River.
Milwaukee Metropolitan Sewerage District (1980c)		x				x	x		x			x					Report on Franklin - Northeast Interceptor Facility plan. It examines the status of the Root River and the effects that the proposed plan will have on it.
Milwaukee Metropolitan Sewerage District (1980d)												x					Local plan for Jones Island Facility. It discusses existing environmental status and the impacts the plan will have on Milwaukee's Harbor and also includes some information on the tributaries leading into the harbor.

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Milwaukee Metropolitan Sewerage District (1980e)		x										x										Report on the Mitchell Field South Interceptor Facility Plan. It examines the status of water in Mitchell Field Ditch and in Oak Creek and states the effects that the plan may have on it.
Milwaukee Metropolitan Sewerage District (1980h)		x										x										Report on the Oak Creek North Branch Interceptor Facility Plan. It examines the status of Oak Creek and reports the effects that the plan may have on it.
Milwaukee Metropolitan Sewerage District (1980j)			x	x	x							x										Local plan for MMSD’s Underwood Creek Interceptor Facility with an environmental assessment on Underwood Creek, Dousman Ditch, and the Menomonee River. It discusses land use, some point sources of pollution and physio-chemical characteristics.
Milwaukee River Revitalization Council (multiple years)		x																x				Local report on the Milwaukee River. It states what has been done in the past year to improve water quality on the river. It also informs the reader of upcoming projects.
Milwaukee River Revitalization Council and Wiscosin Department of Natual Resources (1991)		x																x				Regional examination of the Milwaukee River. They divide the study area into sections and discuss the problems of each, but no hard data is presented.
Mortimer (1981)				x	x																	Overview of a court case with the state of Illinois vs. Milwaukee and near-by cities. The issue of concern was pollution of Lake Michigan by sewer overflows and discharges.
Mymudes (1991)					x																	Multi-state study on the varying characteristics of an aquatic plant species Plan-tago cordata throughout its range.
Nichols (1974)					x									x				x				Statewide examination of aquatic plant control methods. It looks at control by harvesting and habitat manipulation. Milwaukee County is in the harvesting experiences table.
Nichols and Vennie (1991)	x		x		x		x		x					x								Statewide study on lake plants. Habitat preferences are given as well as their value to the environment and wildlife. There is also information on propagation and herbicide susceptibility.

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Novitzki (1979)															x							Statewide description of wetlands in Wisconsin. It gives descriptions of different types of wetlands that are found in the state.
Novotny and Ben-doricchio (1989)		x			x																	Local study with information on the Menomonee River watershed and some of the tributaries and creeks within the watershed. The model LANDRUN was used for estimating sediment loadings from various land uses and other factors like soil characteristics and imperviousness. Phosphorus loadings were also examined.
Nowak (1995)														x	x	x		x				Local look into a court case regarding the concrete lining that was put into Cray-fish Creek in the city of Oak Creek, WI.
Oberts (1977)																x		x				Discusses water quality effects of commonly used management practices used to control pollution from urban activities. These include construction, runoff, litter, and combined sewer overflows. There is some information for Milwaukee given.
Pariso and others (1983)		x	x																			Regional study of Wisconsin's coast. Milwaukee, Kinnickinnic, Root, and Meno-monee Rivers and Oak Creek were included in the study. Fish, sediment, and effluent samples were tested for contaminants.
Pentecost and Vogt (1976)						x						x		x								Multi-state examination of amphibian and reptile distribution. It also discusses plant communities found in the area and their associated herptofauna.
Peters (1997)			x	x	x																	Regional study on Western Lake Michigan Drainages. It is a compilation of arti-cles on natural and anthropogenic features of the area that have an impact on water quality. These include geology, climate, vegetation, land use, and hydrologic and biological characteristics.
R.A. Smith & Associ-ates Inc. and others (1996)														x		x						Local study on the Menomonee River. It evaluates the potential of returning it to a more natural state and improving recreational access. Some of the proposed ideas were creating a wetland, making a trail, and removing the concrete lining.
Read (1976)					x																	Statewide report on endangered and threatened plants in Wisconsin. It provides lists of plants by region and habitat type.
Rice (1992)			x	x	x	x	x				x			x	x			x		x		Report on the nonpoint source water pollution abatement program for the Root River. It evaluates the degree to which the project objectives of reducing levels of fecal coliform, dissolved phosphorus, and DO were accomplished.

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Science Applications International Corpora- tion (1993)			x				x															Multi-state study on the Lake Michigan Basin. The purpose was to inform the public and get their comments on agencies' activities and future actions. Informa- tion on the effects of toxic pollutants in the Great Lakes and their sources is given
Scudder and others (1996)			x	x	x	x	x			x	x								x			Regional study of the Western Lake Michigan Drainage Basin. It contains a sum- mary of biology in the region. It also has tables of references that have information on biological investigations.
Scudder and others (1997)		x	x	x	x																	Regional study on the Western Lake Michigan Drainages. Sampling sites included the Milwaukee River, Kinnickinnic River, and Lincoln Creek. Trace elements and synthetic organic compounds were examined in sediment and biota and were related to bedrock and land use.
Southeastern Regional Planning Commission (1976)		x	x			x	x		x			x		x								Local study on the Menomonee River watershed to provide a plan that will work on the flooding problems and increase the health of the river and its use as a habi- tat. Physical description of the area is given along with wildlife that is found there. Data for flooding and surface water monitoring is also given.
Southeastern Wiscon- sin Regioanl Planning Commission (1986c)		x	x			x	x		x			x		x	x							Local study on the Oak Creek watershed to provide a plan that will address flood- ing problems and increase the health of the river and its use as a habitat. A physi- cal description of the area is given along with wildlife that is found there. Data for flooding and surface water monitoring is also given.
Southeastern Wiscon- sin Regioanl Planning Commission (1987a)		x	x	x	x		x		x			x		x	x						x	Local study on the Milwaukee Harbor Estuary which involves the Milwaukee, Menomonee, and Kinnickinnic Rivers, and the Harbor. The purpose was to pre- pare a plan that will assist in controlling pollution, mitigate flood problems, con- trol storm damage in the harbor, and improve water quality for recreational uses. Monitoring data is given.
Southeastern Wiscon- sin Regional Planning Commission (1979)		x		x								x										Local study on the Oak Creek Watershed, which also includes the Mitchell Field Drainage Ditch. Existing water quality was evaluated as they formed a program to address flooding, water pollution and other related problems.
Southeastern Wiscon- sin Regional Planning Commission (1980)		x		x																x		Local study on the Root River and its tributaries. This plan is for the control of pollution of both urban and rural sources.

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Southeastern Wisconsin Regional Planning Commission (1971)							x		x						x							Regional study on the Milwaukee River to show the need for comprehensive regional planning. It discusses existing water conditions and problems and gives possible solutions. Topics covered include flooding, water quality, water supply, and recreation.
Southeastern Wisconsin Regional Planning Commission (1974)																		x				Local study on the Kinnickinnic River watershed. The purpose is to show the need for a comprehensive watershed planning program to reduce pollution and flooding.
Southeastern Wisconsin Regional Planning Commission (1978c)			x																			Regional study on the Lake Michigan Drainage Area in Southeastern Wisconsin. The purpose is to show the need for, the major elements, and the organizations of a comprehensive planning program. It has information on the Root River and the Milwaukee Harbor Estuary.
Southeastern Wisconsin Regional Planning Commission (1988b)															x			x				Regional report on conference proceedings discussing achieving water quality through land management. Issues addressed included erosion control, stormwater management, nonpoint source water pollution, environmental corridors, floodplains, and wetlands.
Southeastern Wisconsin Regional Planning Commission (1993)		x	x	x										x				x				Local plan for flood and stormwater management for Lilly Creek subwatershed. Evaluates alternative plans in hopes to eliminate current problems and avoid future ones while also considering nonpoint source pollution and river habitat.
Southeastern Wisconsin Regional Planning Commission (1996)	x		x		x	x	x		x					x				x				Local management plan for Little Muskego Lake. With the plan they hope to reduce sediment and contaminant loading to the lake, reduce aquatic macrophyte and algal growths, promote public awareness, improve aesthetics and use for recreation, and improve habitat for fish and other wildlife.
Southeastern Wisconsin Regional Planning Commission and others (2000)			x	x								x		x						x		Local study on Dousman Ditch and Underwood Creek subwatershed of the Menomonee River watershed. It identifies stormwater management and flooding problems and their causes. It also sets forth a management plan after examining alternatives.
Sullivan (1997)		x	x											x						x		Regional study on the Western Lake Michigan Drainages including Lincoln Creek. Fish communities were analyzed, as was the river habitat. They were then used as water quality indicators.

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Taylor (1994)		x									x											Local study on the Kinnickinnic River examining nonpoint sources of pollution. The main issues are urban runoff and erosion from construction sites and stream-banks.
Thompson and others (1976)			x						x					x								Regional study of townships in Wisconsin along the Lake Michigan shoreline. It looks at fish and wildlife habitat and classifies it into three categories.
Torke (1976)			x																			Statewide study of cyclopoid copepods. It contains a key for identification and has information on their distributions and ecology.
U.S. Environmental Protection Agency and others (1980b)			x								x				x							Local study of MMSD area addressing the proposed Master Facilities Plan. It concentrates on the issue of overflows due to infiltration of ground water and storm-water. They discuss current water quality and how the plan will affect it.
Van Dyke (1977)							x															Local study on mallard duck populations and production in Juneau Park, Milwaukee County. It also examines winter populations, sex ratios, molting, weights, and behavior.
Villeneuve and others (1997)		x								x												Local study to determine long term toxicity effects on stream biota from urban stormwater runoff. Fish hepatoma cells were used and exposed to water from Lincoln Creek.
Wisconsin Depart- ment of Natural Resources (1975a)																		x				Regional study summarizing industrial discharges to waters in southeastern Wisconsin. It also discusses permits and compliance schedules.
Wisconsin Depart- ment of Natural Resources (1976)												x										Regional report on southeastern Wisconsin. It includes the Root River and creeks and tributaries in the area. Data from water quality sampling and an evaluation survey conducted during 1973 is presented.
Wisconsin Depart- ment of Natural Resources (1989)			x																			Report on the Milwaukee Area of Concern in the Great Lakes Basin. Menomonee, Kinnickinnic, and Milwaukee Rivers, and the Milwaukee Inner Harbor are included in the study. The purpose is to present water resource problems and what stage they are at for remediation. It presents toxics data, including those found in fish, and gives further recommendations for the Remedial Action Plan.

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Wisconsin Department of Natural Resources (1990)			x			x	x		x		x			x		x						Local study on the Menomonee River Watershed to create a management plan. It identifies major environmental concerns and details strategies for improvement. Water resources information is given by subwatershed with information on wild-life and habitat, land use, solid and hazardous waste, and nonpoint source pollution.
Wisconsin Department of Natural Resources (1992b)			x																			Statewide study to establish a database on the distribution and abundance of all fish species. It compares the 1900-1972 distributions to the studies in 1974-1986.
Wisconsin Department of Natural Resources (1992c)	x	x	x			x	x		x		x			x	x			x				Local study on Milwaukee River South Watershed area. The existing water quality and environmental concerns such as habitat and sewage treatment plants are described and possible water pollution causes and management strategies are outlined.
Wisconsin Department of Natural Resources (1993)	x	x	x																			Local study on the Wind and Muskego Lakes and the tributaries leading into them. It examines nonpoint source pollution with the main focus on sediment loads.
Wisconsin Department of Natural Resources (1994)		x	x	x	x				x		x	x		x				x				Local study of Milwaukee Estuary and rivers leading into it. It identifies environmental problems and impaired uses and gives a brief overview of each. Following that are recommendations for plans to restore the water quality.
Wisconsin Department of Natural Resources (1995)													x		x							Statewide information on purple loosestrife and its effect on wetlands. It gives distribution, identification, and control information.
Wisconsin Department of Natural Resources (1999)			x																			Report for the entire Milwaukee River Basin. The purpose was to develop a public process to determine useful measurements for describing ecosystem conditions. Many possible indicators including air, water, biodiversity, and education are discussed and a little data is presented for VOCs, fish advisories, ozone, transportation, and land use.
Wisconsin Department of Natural Resources (multiple years)			x										x					x				Statewide reports on water quality with some specific information on Milwaukee County and the surrounding area. They cover a variety of topics including PCBs in fish, pollution and some chemical parameters as well. There is data for the Milwaukee River, Milwaukee Estuary, Lincoln Creek, and North Avenue Dam.

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Wisconsin Department of Natural Resources (multiple years)		x	x	x										x						x		Statewide study using six watersheds as study areas. This includes Milwaukee River South. The goal of the study was to determine the extent to which management practices improved fish habitat and communities.
Wisconsin Department of Natural Resources and others (2001)														x	x							A look at the entire Milwaukee River and the streams in its basin. It includes individual descriptions of areas within the basin. Topics covered include point and nonpoint sources of pollution, wetlands, and stream and shoreline modifications.
Wisconsin Department of Natural Resources and South-eastern Wisconsin Regional Planning Commission (1985)		x	x	x										x								Study of the Milwaukee River watershed including the rivers and tributaries that flow into it. It examines the water quality and other factors in an attempt to discern the best way to carry out an effective priority watershed program.
Wisconsin District Lake Studies Team (multiple years)	x				x																	Statewide reports on the physical and chemical characteristics of Wisconsin lakes. The studies include Little and Big Muskego Lakes.

Table 1: Selected GIS Coverages available for the MMSD Planning Area

[NA, not available]

Data Set Name	Source year	Data Provider	Description	Scale	Data Extent
Boundary					
MMSD study unit boundary	NA	SEWRPC ^a	Boundary of the 420 mile ² MMSD service area	NA	MMSD planning area (Milwaukee county plus parts of Ozaukee, Racine, Washington, and Waukesha counties)
County base maps	1985, 1990, 1995	USGS/ SEWRPC	County boundaries	1:4,800	SEWRPC counties ^b
Civil Division boundaries	1985, 1990, 1995	SEWRPC	Municipality boundaries	1:4,800	SEWRPC counties
Landnet Locations	Various	WDNR ^c	Public Land Survey System (PLSS) section and townships as derived from USGS 7.5 minute topographic quadrangles (source data from various years)	1:24,000	Wisconsin
Minor Civil Divisions	1991	WDNR	Incorporated and unincorporated cities, civil townships (commonly known as "towns"), and villages of Wisconsin as of 1991 as derived from the US Census Bureau's 1991 TIGER/Line files	1:100,000	Wisconsin
County boundaries	1990	WDNR	County boundaries as derived from the U.S. Census Bureau's 1990 TIGER/Line files.	1:100,000	Wisconsin
Wisconsin State Boundary	1990	WDNR	Wisconsin state boundary as derived from the U.S. Census Bureau's 1990 TIGER/Line files.	1:100,000	Wisconsin

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DNR Geographic Management Units	1996	WDNR	GMUs are administrative units established by the Wisconsin DNR primarily for internal management purposes. Most GMU boundaries are based upon water basin boundaries, though in some areas GMU boundaries have been adjusted to coincide with county boundaries. Scales of data vary from 1:24,000 (boundaries derived from watersheds coverage) to 1:100,000 (boundaries derived from counties coverage).	1:24,000 to 1:100,000	Wisconsin
DNR Administrative Regions	1990	WDNR	DNR Administrative region boundaries generally coincide with county boundaries. DNR administrative regions were established circa 1997 as part of the agency's re-organization.	1:100,000	Wisconsin
Elevation					
Digital planimetric and topographic maps (2 ft contours)	Various	SEWRPC	Planimetric features include building footprints, road edges and curblines, sidewalks, and trees. Topographic features are those that define elevation information. See Land Information and Computer Graphics Facility (LICGF) webpage for more information: http://www.lic.wisc.edu/	1:100 or 1:200	Milwaukee, Ozaukee, Racine Counties
1-Degree Digital Elevation Model	NA	WDNR	A detailed USGS 7.5-Minute DEM is derived from 1:24,000-scale, 7.5-minute topographic maps, and have a 30-meter pixel cell size, or resolution. WDNR also has Digital Elevation Model datasets that are available at a detailed and generalized level as derived from 1:250,000-scale map data.	1:24,000	Wisconsin
Geology and Soils					
Soil mapping units	NA	USDA NRCS/SEWRPC	Soil mapping units	1:15,840	SEWRPC counties
NRCS Soil Survey Data (SSURGO)	Varies	NRCS	SSURGO data include soil survey area boundaries, soil boundaries, water boundaries, and conventional and special soil features. Please see the following website for more information: http://www.ftw.nrcs.usda.gov/ssur_data.html	1:12,000 to 1:63,360	US

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Table 1: Selected GIS Coverages available for the MMSD Planning Area

[NA, not available]

Data Set Name	Source year	Data Provider	Description	Scale	Data Extent
NRCS State Soil Survey Data (STATSGO)	1994	NRCS	STATSGO data is generalized from detail soil survey data and contains information regarding available water capacity, soil reaction, salinity, flooding, water table, bedrock, and interpretations for engineering uses. Please see the following website for more information: http://www.ftw.nrcs.usda.gov/stat_data.html	1:250,000	US
Groundwater resources					
Depth to water table	NA	WGNHS/SEWRPC	Depth to water table	1:48,000	SEWRPC counties
Depth to bedrock	NA	WGNHS/SEWRPC	Depth to bedrock	1:48,000	SEWRPC counties
Soil contamination attenuation potential	NA	WGNHS/SEWRPC	Soil contamination attenuation potential	1:48,000	SEWRPC counties
Groundwater contamination potential	NA	WGNHS/SEWRPC	Groundwater contamination potential	1:48,000	SEWRPC counties
Watershed and hydrography					
Floodplain boundaries	NA	SEWRPC	Floodplain boundaries	1:1,200 or 1:2,400	SEWRPC counties
Watershed	Continuous updates	SEWRPC	Watersheds covering the SEWRPC counties	1:24,000	SEWRPC counties
Subwatershed	Continuous updates	SEWRPC	Subwatersheds covering the SEWRPC counties	1:1,200	SEWRPC counties
Subbasin	Continuous updates	SEWRPC	Subbasins covering the SEWRPC counties	1:2,400	SEWRPC counties

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Table 1: Selected GIS Coverages available for the MMSD Planning Area

[NA, not available]

Data Set Name	Source year	Data Provider	Description	Scale	Data Extent
Hydrography (version 2)	Various	WDNR	Hydrography data includes information about surface water features represented on the USGS 1:24,000-scale topographic map series such as perennial and intermittent streams, lakes, and so on.	1:24,000	Wisconsin
Hydrography	1979-89	EPA/USGS	The hydrography data layer is derived from the 1:100,000-scale Digital Line Graphs (DLGs) of the USGS.	1:100,000	Wisconsin
Water lines	1990, 1995	SEWRPC	Water line data includes watershed boundaries, rivers, channelized rivers, and breakwaters. Data for Milwaukee, Ozaukee, and Racine counties from 1995; data for Washington and Waukesha counties from 1990.	1:2,000	SEWRPC counties
Water related	1990, 1995	SEWRPC	Water related data includes waterbody and marsh locations. Data for Milwaukee, Ozaukee, and Racine counties from 1995; data for Washington and Waukesha counties from 1990.	1:2,000	SEWRPC counties
DNR Watersheds	Varies	WDNR	DNR watershed delineations generally indicate areas that drain into a common river system or lake, but may also be based on DNR basin management criteria.	1:24,000	Wisconsin
Infrastructure					
Sewer service areas	NA	SEWRPC	Sewer service areas	1:48,000	SEWRPC counties
Roads	1979-1989	WDNR	Highways, roads, trails, and associated features. The data are derived from a subset of the Transportation files of the U.S. Geological Survey's Digital Line Graphs.	1:100,000	Wisconsin
Roads	2000	US Dept of Commerce: Bureau of Census	US Dept of Commerce: Bureau of Census	1:100,000	US
Dams	NA	WDNR	Dam locations	NA	Wisconsin

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Table 1: Selected GIS Coverages available for the MMSD Planning Area

[NA, not available]

Data Set Name	Source year	Data Provider	Description	Scale	Data Extent
Misc. Infrastructure (airports, pipelines, etc.)	1979-1989	WDNR	Airports, pipelines, electric transmission lines, and associated infrastructure. This data set is derived from a subset of the Transportation files of the U.S. Geological Survey's Digital Line Graphs	1:100,000	Wisconsin
State Trunk Highways	1988-2000	WDNR	State trunk highway data were derived from a data set developed by the Wisconsin Dept. of Transportation (WisDOT), and called the '1:100,000-scale Roadway Chain' database. data set contains spatial object chain representing the centerline of Wisconsin State, US and Interstate Roadways and selected supporting state-owned roadways such as ramps, connectors, frontage roads.	1:100,000	Wisconsin
Railroads	NA	WDNR	Railroad data were derived from the Wisconsin DOT's '1:100,000-scale Rails Chain Database'. This data set includes all main track and sidings identified in railroad timetables; does not include abandonments.	1:100,000	Wisconsin
Transportation related features	1990, 1995	SEWRPC	Transportation related features such as roads, railroads, and airport terminals. Data for Milwaukee, Ozaukee, and Racine from 1995; data for Washington and Waukesha from 1990	NA	SEWRPC counties
Stream corridors	NA	SEWRPC	Stream corridors are defined as the land within the greatest distance from the watercourse marked by: the SEWRPC primary or secondary environmental corridor boundary; the 100-year regulatory floodplain boundary; the edge of an adjoining wetland; or 75 feet from the watercourse channel or shoreline.	NA	MMSD planning area
Perennial stream lines	NA	SEWRPC	Perennial streams	NA	MMSD planning area
Intermittent stream lines	NA	SEWRPC	Intermittent streams	NA	MMSD planning area
Metropolitan Interceptor System	2003	MMSD	Sewer line locations that are part of the Metropolitan Interceptor System (MIS)	NA	Milwaukee County

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Table 1: Selected GIS Coverages available for the MMSD Planning Area

[NA, not available]

Data Set Name	Source year	Data Provider	Description	Scale	Data Extent
Inline Storage System	2003	MMSD	Sewer line locations that are part of the Inline Storage System (The “Deep Tunnel”) (ISS)	NA	Milwaukee County
Near Surface Collector System	2003	MMSD	Sewer line locations that are part of the Near Surface Collector System (NSC)	NA	Milwaukee County
Combined Sewer Over-flow	2003	MMSD	Sewer line locations that are part of the Combined Sewer Over-flow (CSO)	NA	Milwaukee County
Land use / cover					
Land use	1963, 1970, 1975, 1980, 1985, 1990, 1995	SEWRPC	Land use	1:4,800	SEWRPC counties
Historical urban growth	1995	SEWRPC	Historical urban growth	1:4,800	SEWRPC counties
Vegetation	1985, 1995	SEWRPC	Vegetation	1:4,800	SEWRPC counties
Wildlife habitat	1985, 1995	SEWRPC	Wildlife habitat	1:4,800	SEWRPC counties
Pre-european settlement vegetation	1836	SEWRPC	Pre-european settlement vegetation	1:4,800	SEWRPC counties
Regional land use plan	2010, 2020	SEWRPC	Regional land use plan	1:96,000	SEWRPC counties
Parks and open space sites	NA	SEWRPC	Parks and open space locations	1:48,000	SEWRPC counties
Public lands	1990, 1995	SEWRPC	Public lands by county. Data for Milwaukee, Ozaukee, and Racine from 1995; data for Washington and Waukesha from 1990	1:4,800	SEWRPC counties

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Table 1: Selected GIS Coverages available for the MMSD Planning Area

[NA, not available]

Data Set Name	Source year	Data Provider	Description	Scale	Data Extent
Land Use and Land Cover	1971-1982	WDNR	Land use land cover data are derived from the U.S. Geological Survey Land Use and Land Cover digital dataset at 1:250,000 scale. Land surface features were interpreted by the USGS using National Aeronautics and Space Administration high-altitude aerial photographs, and National High-Altitude Photography (NHAP) program photographs at scales of 1:60,000 or smaller.	1:250,000	Wisconsin
Original Vegetation Cover	mid-1800's	WDNR	Original vegetation cover data was digitized from a 1976 map created from land survey notes written in the mid-1800s when Wisconsin was first surveyed	1:500,000	Wisconsin
WISCLAND Land Cover	1991-93	WDNR	WISCLAND (Wisconsin Initiative for Statewide Cooperation on Landscape Analysis and Data) state land use data was interpreted from land cover from satellite images.	1:40,000 to 1:500,000	Wisconsin
Land Cover	1992	USGS	National Land Cover Data (NLCD) developed from early to mid-90's Landsat Thematic Mapper satellite data with 21 classes of land cover. More information is available at URL: http://land-cover.usgs.gov/natl/landcover.html	30 meter	US
Low resolution land cover	1970	USGS	USGS Geographic Information Retrieval and Analysis (GIRAS) land use land/cover data developed under the Land Use Data Analysis (LUDA) Program in the 1970s and 1980s. Scale 1:250,000 to 1:100,000.	10 acre (man-made); 40 acre (natural)	US
Population					
1990 Census	1990	US Census	Data describing population statistics from the year 1990 census.	NA	US
2000 Census	2000	US Census	Data describing population statistics from the year 2000 census.	NA	US

- For more information on SEWRPC data see: http://www.sewrpc.org/data_publications/default.htm
- SEWRPC counties include Kenosha, Milwaukee, Ozaukee, Racine, Walworth, Washington, Waukesha
- For more information on WDNR Geographic data see: <http://www.dnr.state.wi.us/org/at/et/geo/>. Data descriptions of WDNR data taken in part from metadata describing each dataset available at the above website.

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Table 1: Data sources for the MMSD Corridor Study Database

[data sources incorporated into the database at the time the Phase I Report was written]

Data source name	Agency serving data	Number of sampling sites	Number of sampling visits	Number of results	Date of earliest sample	Date of latest sample	Description of source data set
MMSD Water Quality	MMSD	50	24,137	586,749	1975	2001	Water quality data collected March through November at sites throughout the MMSD planning area and in Lake Michigan (Lake Michigan data is not included in the MMSD Corridor Study Database). MMSD Water Quality data can be viewed at the Great Lakes Water Institute Waterbase website: http://waterbase.glwi.uwm.edu/mmsd.html . Constituents collected include nutrients, field parameters, major ions, PCBs, PAHs, mercury, bacteria, and others.
MMSD Stream Elevation	MMSD	4	216,422	216,422	1994	2001	Stream elevation data collected hourly at 4 sites throughout the MMSD planning area
MMSD Precipitation	MMSD	20	1,411,757	1,411,757	1993	2001	Rain gauge data collected at 5 minute intervals at 4 locations around the MMSD Planning area. Precipitation data is stored at hourly increments in the Corridor Study database.
MMSD Sediment	MMSD	209	3,653	15,322	2000	2001	MMSD cross section and pebble/sieve count information for many sites in the Menomonee River watershed collected as part of the MMSD Menomonee River Sediment Transport Study.
USGS Water Quality	USGS	96	8,918	107,181	1970	2002	Water quality data collected by the USGS as part of many different projects. Constituents include field parameters, major ions, nutrients, pesticides, organics, fecal coliform, and many others.

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Data source name	Agency serving data	Number of sampling sites	Number of sampling visits	Number of results	Date of earliest sample	Date of latest sample	Description of source data set
USGS Streamflow	USGS	42	113,524	113,524	1970	2001	Streamflow data collected at 15 minute intervals at many sites (stored only as daily mean values in the MMSD Corridor Study database).
USEPA STORET Legacy	USEPA	324	6,268	26,930	1970	1998	Water quality database compiled by USEPA from data collected by many different agencies (mainly the WDNR in the Milwaukee area). The legacy database contains data up to 1/1/1999 when a new version of the STORET database was enacted. Constituents include field parameters, nutrients, major ions, organics, pesticides, and others.
USEPA STORET Modern	USEPA	18	515	2,120	1999	2001	Water quality database compiled by the USEPA from data collected by many different agencies (mainly the WDNR in the Milwaukee area). The modern database contains data starting 1/1/1999 when a new version of the STORET database was released. Constituents include field parameters, nutrients, major ions, organics, pesticides, and others.
WDNR Biology Database - Fish	WDNR	289	337	5,569	1970 ^a	2001	WDNR biology database created in 2001 to hold fish, habitat, macroinvertebrate and other biology related data for the WDNR. Community taxonomy, counts, sex, and length included.
WDNR Biology Database - Habitat	WDNR	44	6,345	204,957	1991	2001	WDNR biology database created in 2001 to hold fish, habitat, macroinvertebrate and other biology related data for the WDNR. Various habitat measures including streambank erosion, riparian vegetation, stream substrate are included.

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Table 1: Data sources for the MMSD Corridor Study Database

[data sources incorporated into the database at the time the Phase I Report was written]

Data source name	Agency serving data	Number of sampling sites	Number of sampling visits	Number of results	Date of earliest sample	Date of latest sample	Description of source data set
WDNR Milwaukee Fish	WDNR	18	36	8,166	1996	2001	Access database of fish in the Milwaukee River. Community and count information included.
WDNR Sediment	WDNR	167	343	15,631	1984	1995	Access database of water and sediment samples analyzed for PCBs.
WDNR - UW Stevens Point Professor Szczytko Macroinvertebrates	UWSP - Professor Stan Szczytko	189	328	5,729	1979	1999	Macroinvertebrate data analyzed by UW - Stevens Point Professor Stan Szczytko. Most data is collected by the WDNR but there are other samples from USGS, etc. Community, count, and index information available.

a. Data available in MMSD Corridor Study database for 1900 through 2001

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Table 1: Constituents used in calculating statistics for summary statistics tables, maps, and boxplots

[#/100 mL, number of colonies per 100 milliliters; mg/L, milligrams per liter; mg/m³, milligrams per meter cubed; µs/cm, microsiemens per centimeter; µg/g, micrograms per gram; µg/L, micrograms per gram; the original constituent description information is taken from the source without alteration and may contain many abbreviations]

Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
pH	Standard units	1	Ph	Ph	STD. UNITS @ 25°	USEPA STORET Modern	1
			Ph. Dissolved	Ph, Dissolved	STD. UNITS @ 25°	USEPA STORET Modern	pH (dissolved)
			Ph. Std. Units	Ph, Std. Units	STANDARD UNITS	MMSD Water Quality	pH
			Ph. Wh. Field	Ph, Water, Whole, Field, Standard Units	STANDARD UNITS	USGS QWDATA	00400
Alkalinity	mg/L as CaCO ³	1	Alkalinity. Carbonate as Caco3. Total	Alkalinity, Carbonate as Caco3, Total	MG/L AS CACO3	USEPA STORET Modern	17 (total)
			Alkalinity.Dis.It.F	Alkalinity, Water, Dissolved, Total, Incremental Titration, Field, mg/L as Caco3	MG/L AS CACO3	USGS QWDATA	39086
			T Alk Caco3 mg/L	Alkalinity, Total (mg/L as Caco3)	MG/L AS CACO3	USEPA STORET Legacy	00410
			Total Alkalinity mg/L	Total Alkalinity mg/L	MG/L AS CACO3	MMSD Water Quality	Alkalinity
Hardness	mg/L as CaCO ³	1	Hardness mg/L	Hardness mg/L	MG/L AS CACO3	MMSD Water Quality	Hardness
			Hardness Total	Hardness Total (mg/L as Ca03)	MG/L AS CACO3	USGS QWDATA	00900
			Hardness. Carbonate. Total	Hardness, Carbonate, Total	MG/L	USEPA STORET Modern	259 (total)
			Tot Hard Caco3 mg/L	Hardness, Total (mg/L as Caco3)	MG/L AS CACO3	USEPA STORET Legacy	00900

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Table 1: Constituents used in calculating statistics for summary statistics tables, maps, and boxplots

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Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
Specific Conductance	µS/cm	1	Conductance. Specific	Specific Conductance	UMHO/CM @ 25° C	USEPA STORET Modern	139
			Specific Conductance	Specific Conductance (Microsiemens/ Cm At 25 Deg. C)	US/CM @ 25C	USGS QWDATA	00095
			Specific Conductance	Specific Conductance Microsiemens/ Cm At 25 Deg C	US/CM	USGS QWDATA	90095
			Specific Conductivity Umhos/Cm	Specific Conductivity Umhos/Cm	UMHO/CM	MMSD Water Quality	Conductivity
Dissolved Oxygen, mg/L	mg/L	1	Dissolved Oxygen mg/L	Dissolved Oxygen mg/L	MG/L	MMSD Water Quality	DO
			Dissolved Oxygen. Dissolved	Dissolved Oxygen (Do), Dissolved	MG/L	USEPA STORET Modern	201 (dissolved)
			Do mg/L	Oxygen, Dissolved mg/L	MG/L	USEPA STORET Legacy	00300
			Oxygen Dissolved	Oxygen Dissolved (mg/L)	MG/L	USGS QWDATA	00300
Biochemical Oxygen Demand, 5 Day	mg/L	1	Biochemical Oxygen Demand. 5 Day mg/L	Biochemical Oxygen Demand, 5 Day mg/L	MG/L	MMSD Water Quality	BOD5
			Bod 5 Day mg/L	Bod, 5 Day, 20 Deg C mg/L	MG/L	USEPA STORET Legacy	00310
			Bod 5-Day At 20 Deg	Biochemical Oxygen Demand, 5-Day At 20 Degrees Celsius (mg/L)	MG/L	USGS QWDATA	00310
			Bod. Total. 5 Day	Bod, Biochemical Oxygen Demand, Total, 5 Day	MG/L	USEPA STORET Modern	34 (total)
Solids, Total Suspended	mg/L	1	Solids. Total Suspended	Total Suspended Solids (Tss)	MG/L	USEPA STORET Modern	456
			Solids. Total Suspended. Dissolved	Total Suspended Solids (Tss), Dissolved	MG/L	USEPA STORET Modern	456 (dissolved)
			Total Solids mg/L	Total Solids mg/L	MG/L	MMSD Water Quality	Tot_solids

Table 1: Constituents used in calculating statistics for summary statistics tables, maps, and boxplots

[#/100 mL, number of colonies per 100 milliliters; mg/L, milligrams per liter; mg/m³, milligrams per meter cubed; µs/cm, microsiemens per centimeter; µg/g, micrograms per gram; µg/L, micrograms per gram; the original constituent description information is taken from the source without alteration and may contain many abbreviations]

Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
Residue On Evaporation	mg/L	1	Residue Dis 180c	Solids, Residue On Evaporation At 180 Deg C, Dissolved (mg/L)	MG/L	USGS QWDATA	70300
			Residue Solids	Solids, Residue On Total Evaporation At 105 Degrees Celcius (mg/L)	MG/L	USGS QWDATA	00500
			Residue Total mg/L	Residue, Total (mg/L)	MG/L	USEPA STORET Legacy	00500
Sodium, Dissolved	mg/L	1	Sodium Dissolved	Sodium Dissolved (mg/L as Na)	MG/L AS NA	USGS QWDATA	00930
			Sodium. Dissolved	Sodium, Dissolved	MG/L	USEPA STORET Modern	451 (dissolved)
Chloride, Total	mg/L as CL	1	Chloride mg/L	Chloride mg/L	MG/L	MMSD Water Quality	Chloride
			Chloride Total mg/L	Chloride, Total In Water mg/L	MG/L	USEPA STORET Legacy	00940
			Chloride. Total	Chloride, Total	MG/L	USEPA STORET Modern	107 (total)
Potassium, Dissolved	mg/L	1	Potassium Dissolved	Potassium Dissolved (mg/L as K)	MG/L AS K	USGS QWDATA	00935
			Potassium. Dissolved	Potassium, Dissolved	MG/L	USEPA STORET Modern	392 (dissolved)
Nitrogen, Total	mg/L as N	1	Nitrogen Total	Nitrogen Total (mg/L as N)	MG/L AS N	USGS QWDATA	00600
		0.2259	Nitrogen. Total -No3	Nitrogen, Total (mg/L as No3)	MG/L AS NO3	USGS QWDATA	71887
Nitrogen, Kjeldahl (Ammonia Plus Total Organic Nitrogen), Total ^a	mg/L as N	1	Nitrogen Amm+Org Tot	Nitrogen Ammonia Plus Organic Total (mg/L as N)	MG/L AS N	USGS QWDATA	00625
			Nitrogen. Kjeldahl. Total	Nitrogen, Kjeldahl, Total	MG/L	USEPA STORET Modern	333 (total)
			Tot Kjel N mg/L	Nitrogen, Kjeldahl, Total, (mg/L as N)	MG/L AS N	USEPA STORET Legacy	00625
			Total Kjeldahl Nitrogen mg/L	Total Kjeldahl Nitrogen mg/L	MG/L AS N	MMSD Water Quality	TKN

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Table 1: Constituents used in calculating statistics for summary statistics tables, maps, and boxplots

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Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
Nitrogen, Nitrate, Dissolved	mg/L as N	1	Nitrate Nitrogen	Nitrate Nitrogen	MG/L AS N	MMSD Water Quality	NITRATE
			Nitrogen Nitrate D.	Nitrogen Nitrate Dissolved (mg/L as N)	MG/L AS N	USGS QWDATA	00618
			Nitrogen Nitrate T.	Nitrogen Nitrate Total (mg/L as N)	MG/L AS N	USGS QWDATA	00620
			Nitrogen, Nitrite + Nitrate, Dissolved	Nitrogen, Nitrite (No2) + Nitrate (No3), Dissolved	MG/L	USEPA STORET Modern	336 (dissolved)
			No2 + No3 Dissolved	Nitrogen Nitrite Plus Nitrate Dissolved (mg/L as N)	MG/L AS N	USGS QWDATA	00631
			No2 + No3 Total	Nitrogen Nitrite Plus Nitrate Total (mg/L as N)	MG/L AS N	USGS QWDATA	00630
			No2&No3 N-Diss mg/L	Nitrite Plus Nitrate, Diss. 1 Det. (mg/L as N)	MG/L AS N	USEPA STORET Legacy	00631
			No3-N Diss mg/L	Nitrate Nitrogen, Dissolved (mg/L as N)	MG/L AS N	USEPA STORET Legacy	00618
		0.2259	N. Nitrate Total	Nitrogen, Nitrate, Total (mg/L as No3)	MG/L AS NO3	USGS QWDATA	71850
			Nitr. No3 as No3 Dis	Nitrogen, Nitrate, Dissolved (mg/L as No3)	MG/L AS NO3	USGS QWDATA	71851
Nitrogen, Organic Nitrogen, Total ^a	mg/L as N	1	Nitrogen Organic T.	Nitrogen Organic Total (mg/L as N)	MG/L AS N	USGS QWDATA	00605

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Table 1: Constituents used in calculating statistics for summary statistics tables, maps, and boxplots

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Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
Nitrogen, Ammonia, Dissolved ^a	mg/L as N	1	Ammonia Nitrogen	Ammonia Nitrogen	MG/L AS N	MMSD Water Quality	Ammonia
			Nh3+Nh4- N Diss mg/L	Nitrogen, Ammonia, Dissolved (mg/L as N)	MG/L AS N	USEPA STORET Legacy	00608
			Nh3+Nh4- N Total mg/L	Nitrogen, Ammonia, Total (mg/L as N)	MG/L AS N	USEPA STORET Legacy	00610
			Nitrogen Ammonia D.	Nitrogen Ammonia Dissolved (mg/L as N)	MG/L AS N	USGS QWDATA	00608
			Nitrogen Ammonia T.	Nitrogen Ammonia Total (mg/L as N)	MG/L AS N	USGS QWDATA	00610
			Nitrogen. Ammonia. Dissolved	Nitrogen, Ammonia (Nh3), Dissolved	MG/L	USEPA STORET Modern	330 (dissolved)
			Nitrogen. Ammonia. Total	Nitrogen, Ammonia (Nh3), Total	MG/L	USEPA STORET Modern	330 (total)
		0.7765	Nitr. Nh4 as Nh4 Dis	Nitrogen, Ammonia, Dissolved (mg/L as Nh4)	MG/L AS NH4	USGS QWDATA	71846
		0.7765	Nitrogen. Nh4. Total	Nitrogen, Ammonia, Total (mg/L as Nh4)	MG/L AS NH4	USGS QWDATA	71845
Phosphorus, Total	mg/L as P	1	Phos-Tot mg/L P	Phosphorus, Total (mg/L as P)	MG/L AS P	USEPA STORET Legacy	00665
			Phosphorus as P. Total	Phosphorus as P, Total	MG/L AS P	USEPA STORET Modern	1473 (total)
			Phosphorus Total	Phosphorus Total (mg/L as P)	MG/L AS P	USGS QWDATA	00665
			Total Phosphorus mg/L	Total Phosphorus mg/L	MG/L AS P	MMSD Water Quality	Tot_phos
		0.001	Phosphor Wtr Tot Rec Ug/L	Phosphorus (P), Water, Total Recoverable Ug/L	UG/L	USEPA STORET Legacy	00662
		0.3262	Phosphorus Tot Po4	Phosphorus Total (mg/L as Po4)	MG/L AS PO4	USGS QWDATA	71886

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Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
Phosphorus, Ortho	mg/L as P	1	Phos Ortho Tot as P	Phosphorus Orthophosphate, Total (mg/L as P)	MG/L AS P	USGS QWDATA	70507
			Phos-Dis Ortho mg/L P	Phosphorus, Dissolved Orthophosphate (mg/L as P)	MG/L AS P	USEPA STORET Legacy	00671
			Phos-T Ortho mg/L P	Phosphorus, In Total Orthophosphate (mg/L as P)	MG/L AS P	USEPA STORET Legacy	70507
			Phosphorus Ortho D.	Phosphorus Orthophosphate Dissolved (mg/L as P)	MG/L AS P	USGS QWDATA	00671
			Phosphorus. Orthophosphate as P. Dissolved	Phosphorus, Orthophosphate as P, Dissolved	MG/L AS P	USEPA STORET Modern	1476 (dissolved)
Phosphorus, Dissolved	mg/L as P	1	Phosphorus as P. Dissolved	Phosphorus as P, Dissolved	MG/L AS P	USEPA STORET Modern	1473 (dissolved)
			Phosphorus Diss.	Phosphorus Dissolved (mg/L as P)	MG/L AS P	USGS QWDATA	00666
			Total Soluble Phosphorus mg/L	Total Soluble Phosphorus mg/L	MG/L AS P	MMSD Water Quality	Tot_sol_phos
Cadmium, Total, Sedimentt	µg/g as Cd	1	Cadmium Bot. Mat.	Cadmium Total In Bottom Material (Ug/G as Cd)	UG/G AS CD	USGS QWDATA	01028
			Cd Mud Dry Wgt Mg/Kg-Cd	Cadmium, Total In Bottom Deposits (Mg/Kg, Dry Wgt)	MG/KG	USEPA STORET Legacy	01028
Cadmium, Total, Water	µg/L as Cd	1	Cadmium Cd.Tot Ug/L	Cadmium, Total (Ug/L as Cd)	UG/L AS CD	USEPA STORET Legacy	01027
			Cadmium Total	Cadmium Total (Ug/L as Cd)	UG/L AS CD	USGS QWDATA	01027
			Cadmium. Total	Cadmium, Total	UG/L	USEPA STORET Modern	74 (total)
			Total Cadmium (Analyzed By Graphite Furnace Atomic Absorption) Ug/L	Total Cadmium (Analyzed By Graphite Furnace Atomic Absorption) Ug/L	UG/L	MMSD Water Quality	Cadmium

Table 1: Constituents used in calculating statistics for summary statistics tables, maps, and boxplots

[#/100 mL, number of colonies per 100 milliliters; mg/L, milligrams per liter; mg/m³, milligrams per meter cubed; µs/cm, microsiemens per centimeter; µg/g, micrograms per gram; µg/L, micrograms per gram; the original constituent description information is taken from the source without alteration and may contain many abbreviations]

Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
Mercury, Total, Sediment	µg/g as Hg	1	Mercury Btm	Mercury, Recoverable From Bottom Material, Ug/G as Hg	UG/G AS HG	USGS QWDATA	71921
			Mercury Sedmg/Kg Dry Wgt	Mercury,Tot. In Bot. Depos. (Mg/Kg as Hg Dry Wgt)	MG/KG AS HG	USEPA STORET Legacy	71921
Mercury, Total, Water	µg/L as Hg	1	Mercury (Total) Aa Cold Vapor	Mercury (Total) Aa Cold Vapor	UG/L	MMSD Water Quality	340
			Mercury Hg.Total Ug/L	Mercury, Total (Ug/L as Hg)	UG/L AS HG	USEPA STORET Legacy	71900
			Total Mercury	Total Mercury	UG/L	MMSD Water Quality	HG
Copper, Total, Sediment	µg/g as Cu	1	Copper Bot. Mat.	Copper Total In Bottom Material (Ug/G as Cu)	UG/G AS CU	USGS QWDATA	01043
			Copper Mud Dry Wt	Copper Mud Dry Wt	MG/KG	USEPA STORET Legacy	01043
Copper, Total, Water	µg/L as Cu	1	Copper Cu.Tot Ug/L	Copper, Total (Ug/L as Cu)	UG/L AS CU	USEPA STORET Legacy	01042
			Copper Total	Copper Total (Ug/L as Cu)	UG/L AS CU	USGS QWDATA	01042
			Copper. Total	Copper, Total	UG/L	USEPA STORET Modern	140 (total)
			Total Copper Ug/L	Total Copper Ug/L	UG/L	MMSD Water Quality	Copper
Lead, Total, Sedi-ment	µg/g as Pb	1	Lead Sedmg/Kg Dry Wgt	Lead In Bottom Deposits (Mg/Kg as Pb Dry Wgt)	MG/KG as PB	USEPA STORET Legacy	01052
			Lead Total Bot. Mat.	Lead Total In Bottom Material (Ug/G as Pb)	UG/G AS PB	USGS QWDATA	01052
Lead, Total, Water	µg/L as Pb	1	Lead Pb.Tot Ug/L	Lead, Total (Ug/L as Pb)	UG/L AS PB	USEPA STORET Legacy	01051
			Lead Total	Lead Total (Ug/L as Pb)	UG/L AS PB	USGS QWDATA	01051
			Lead. Total	Lead, Total	UG/L	USEPA STORET Modern	285 (total)
			Total Lead (Analyzed By Graphite Furnace Atomic Absorption) Ug/L	Total Lead (Analyzed By Graphite Furnace Atomic Absorption) Ug/L	UG/L	MMSD Water Quality	Lead

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Table 1: Constituents used in calculating statistics for summary statistics tables, maps, and boxplots

[#/100 mL, number of colonies per 100 milliliters; mg/L, milligrams per liter; mg/m³, milligrams per meter cubed; µs/cm, microsiemens per centimeter; µg/g, micrograms per gram; µg/L, micrograms per gram; the original constituent description information is taken from the source without alteration and may contain many abbreviations]

Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
Arsenic, Total, Sediment	µg/g as As	1	Arsenic Bot. Mat.	Arsenic Total In Bottom Material (Ug/G as As)	UG/G AS AS	USGS QWDATA	01003
			Arsenic Sedmg/Kg Dry Wgt	Arsenic In Bottom Deposits (Mg/Kg as as Dry Wgt)	MG/KG as AS	USEPA STORET Legacy	01003
Arsenic, Total, Water	µg/L as As	1	Arsenic As.Tot Ug/L	Arsenic, Total (Ug/L as As)	UG/L AS AS	USEPA STORET Legacy	01002
			Arsenic Total	Arsenic Total (Ug/L as As)	UG/L AS AS	USGS QWDATA	01002
			Total Arsenic (Analyzed By Graphite Furnace Atomic Absorption) Ug/L	Total Arsenic (Analyzed By Graphite Furnace Atomic Absorption) Ug/L	UG/L	MMSD Water Quality	Arsenic
Nickel, Total, Sediment	µg/g as Ni	1	Nickel Bot. Mat.	Nickel Total In Bottom Material (Ug/G as Ni)	UG/G AS NI	USGS QWDATA	01068
			Nickel Sedmg/Kg Dry Wgt	Nickel, Total In Bottom Deposits (Mg/Kg, Dry Wgt)	MG/KG	USEPA STORET Legacy	01068
Nickel, Total, Water	µg/L as Ni	1	Nickel Ni.Total Ug/L	Nickel, Total (Ug/L as Ni)	UG/L AS NI	USEPA STORET Legacy	01067
			Nickel Total	Nickel Total (Ug/L as Ni)	UG/L AS NI	USGS QWDATA	01067
			Total Nickel Ug/L	Total Nickel Ug/L	UG/L	MMSD Water Quality	Nickel
Chromium, Total, Sediment	µg/g as Cr	1	Chromium Mud Dry Wt	Chromium Mud Dry Wt	MG/KG	USEPA STORET Legacy	01029
			Chromium Total B. M.	Chromium Total In Bottom Material (Ug/G as Cr)	UG/G AS CR	USGS QWDATA	01029
Chromium, Total, Water	µg/L as Cr	1	Chromium Cr.Tot Ug/L	Chromium, Total (Ug/L as Cr)	UG/L AS CR	USEPA STORET Legacy	01034
			Chromium Total	Chromium Total (Ug/L as Cr)	UG/L AS CR	USGS QWDATA	01034
			Total Chromium Ug/L	Total Chromium Ug/L	UG/L	MMSD Water Quality	Chromium
Zinc, Total, Sediment	µg/g as Zn	1	Zinc Bottom Material	Zinc Total In Bottom Material (Ug/G as Zn)	UG/G AS ZN	USGS QWDATA	01093
			Zinc Mud Dry Wgt	Zinc Mud Dry Wgt	MG/KG	USEPA STORET Legacy	01093

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Table 1: Constituents used in calculating statistics for summary statistics tables, maps, and boxplots

[#/100 mL, number of colonies per 100 milliliters; mg/L, milligrams per liter; mg/m³, milligrams per meter cubed; µs/cm, microsiemens per centimeter; µg/g, micrograms per gram; µg/L, micrograms per gram; the original constituent description information is taken from the source without alteration and may contain many abbreviations]

Generalized constituent name	Units for generalized constituent name	Correction factor for generalized constituent name	Original constituent name	Original constituent description	Original units	Source of constituent	Original constituent code
Zinc, Total, Water	µg/L as Zn	1	Total Zinc Ug/L	Total Zinc Ug/L	UG/L	MMSD Water Quality	Zinc
			Zinc Total	Zinc Total (Ug/L as Zn)	UG/L AS ZN	USGS QWDATA	01092
			Zinc Zn.Tot Ug/L	Zinc, Total (Ug/L as Zn)	UG/L AS ZN	USEPA STORET Legacy	01092
			Zinc. Total	Zinc, Total	UG/L	USEPA STORET Modern	545 (total)+Y4
Chlorophyll A, Corrected For Pheophytin	mg/m ³	1	Chlorophyll "A" Mg/M3	Chlorophyll "A" Mg/M3	MG/M3	MMSD Water Quality	Chlorophyll
E. Coli	#/100 mL	1	E. Coli	E. Coli	#/100ML	MMSD Water Quality	EColiQT
Fecal Coliform	#/100 mL	1	Coliform Fecal 0.7	Fecal Coliform .7 Um-Mf (Col/ 100 MI)	COLS./100 ML	USGS QWDATA	31625
			Fec Coli M-Fcagar /100ml	Fecal Coliform,Membr Filter,M-Fc Agar,44.5c,24hr	#/100ML	USEPA STORET Legacy	31613
			Fec Coli Mpncmed /100ml	Fecal Coliform,Mpn,Ec Med,44.5c (Tube 31614)	MPN	USEPA STORET Legacy	31615
			Fecal Coli.Mfc Mf.W	Fecal Coliform, Mfc Mf Method, Water, Colonies/100 MI	COLS./100 ML	USGS QWDATA	31616
			Fecal Coliform Bacteria Mpn/100 MI	Fecal Coliform Bacteria Mpn/100 MI	MPN/100 ML	MMSD Water Quality	F_coliform_MPN

a. This constituent was not analyzed and discussed in the report however it was used to calculated total nitrogen

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Table 1: U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, Canadian Guidelines
[CWA, Clean Water Act]

Reference	Type	Abbreviation	Definition
U.S. Environmental Protection Agency, 2002	Drinking water	MCL	Maximum Contaminant Level - "The highest level of a contaminant that is allowed in drinking water. MCLs are set as close to the MCLG as feasible using the best available analytical and treatment technologies and taking cost into consideration. MCLs are enforceable standards." Maximum Contaminant Level Goal (MCLG) - "A non-enforceable health goal which is set at a level at which no known or anticipated adverse effect on the health of persons occurs and which allows an adequate margin of safety."
U.S. Environmental Protection Agency, 2002a	Drinking water	SDWR	Secondary Drinking Water Regulation - "Non-enforceable Federal guidelines regarding cosmetic effects (such as tooth or skin discoloration) or aesthetic effects (such as taste, odor, or color) of drinking water."
U.S. Environmental Protection Agency, 2000	Ambient water quality for rivers and streams	Nutrient Criteria	Nutrient Criteria for Level II Ecoregion VII, Level III Ecoregion 53 - "EPA's ecoregional nutrient criteria are intended to address cultural eutrophication-- the adverse effects of excess nutrient inputs."...."These criteria provide EPA's recommendations to States and authorized Tribes for use in establishing their water quality standards consistent with section 303(c) of CWA."..."The Clean Water Act establishes a national goal to achieve, wherever attainable, water quality which provides for the protection and propagation of fish, shellfish, and wildlife and recreation in and on the water." The value used in the MMSD Corridor Study report for comparison to median concentrations is the "25th Percentiles based on all seasons data for the Decade" listed in Table 3c, Reference conditions for level III ecoregion 53.
U.S. Environmental Protection Agency, 1986	Ambient water quality for fresh recreational water	Ambient water quality for bacteria	Ambient water quality guideline for bacteria - "...upper limits for densities of indicator bacteria in waters that are associated with acceptable health risks for swimmers."
Wisconsin Department of Natural Resources, 2003	Drinking Water	NR 809 MCL	NR 809 Maximum Contaminant Level - "Maximum Contaminant Levels (MCLs) contained in Chapter 809, Wisconsin Administrative Code. MCLs are the highest level of a contaminant that is allowed in drinking water."

Table 1: U.S. Environmental Protection Agency, Wisconsin Department of Natural Resources, Canadian Guidelines
[CWA, Clean Water Act]

Reference	Type	Abbreviation	Definition
MacDonald and others, 2000	Aquatic life - Sediment	PEC	Probable Effect Concentration - Probable effect concentration, "...above which adverse effects are expected to occur more often than not." "...most of the PECs...provide an accurate basis for predicting sediment toxicity."
MacDonald and others, 2000	Aquatic life - Sediment	TEC	Threshold Effect Concentration - Threshold effect concentration, "...below which adverse effects are not expected to occur...." "...most of the TECs...provide an accurate basis for predicting sediment toxicity."
Health Canada, 2002	Drinking water	MAC	Maximum Allowable Concentration - "MACs have been developed for parameters, or substances, which are known or suspected to cause deleterious health effects. This term assumes the parameter would be consumed over a lifetime at that concentration." (Canadian Ground Water Association, 1999)
Health Canada, 2002	Drinking water	IMAC	Interim Maximum Allowable Concentration - "IMACs are listed for substances for which not enough information is known to determine a Maximum Acceptable Concentration." (Canadian Ground Water Association, 1999)
Health Canada, 2002	Drinking water	AO	Aesthetic Objective - "AOs are for specific parameters which affect water quality based on smell, taste or color. There are substances which fall under aesthetic objectives which in high enough quantities may impose a health risk." (Canadian Ground Water Association, 1999)
Canadian Council of Ministers of the Environment, 2002b	Aquatic life - water	Aquatic life criteria	Water quality guideline for the protection of aquatic life in freshwater - "Guideline values are meant to protect all forms of aquatic life and all aspects of the aquatic life cycles, including the most sensitive life stage of the most sensitive species over the long term" (Canadian Council of Ministers of the Environment, 1999)
Canadian Council of Ministers of the Environment, 2002a	Aquatic life - Sediment	ISQG	Interim Sediment Quality Guideline - "The lower value, referred to as the threshold effect level (TEL), represents the concentration below which adverse biological effects are expected to occur rarely....The definition of the TEL is consistent with the definition of a Canadian sediment quality guideline." An interim guideline is recommended if there is a limited amount of information on methods used to establish guideline values. (Canadian Council of Ministers of the Environment, 2001)
Canadian Council of Ministers of the Environment, 2002a	Aquatic life - Sediment	PEL	Probable Effect Level - "(PEL), defines the level above which adverse effects are expected to occur frequently." (Canadian Council of Ministers of the Environment, 2001)

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